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TRANSACTIONS

OF THE

MASSACHUSETTS HORTICULTURAL SOCIETY

FOR THE YEAR 1918

PART I

PUBLISHED BY THE SOCIETY
BOSTON
NINETEEN HUNDRED AND EIGHTEEN

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Massachusetts Horticultural Society

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Massachusetts Horticultural Society.

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MASSACHUSETTS HORTICULTURAL SOCIETY.

1918.

The Transactions of the Society are issued annually in two parts under the direction of the Committee on Lectures and Publications.

Communications relating to the objects of the Society, its publications, exhibitions, and membership, may be addressed to William P. Rich, Secretary, Horticultural Hall, No. 300 Massachusetts Avenue, Boston, Massachusetts.

FRED A. WILSON, *Chairman*
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THE INAUGURAL MEETING, JANUARY 12, 1918.

TRANSACTIONS

OF THE

Massachusetts Horticultural Society.

1918, PART I.

INAUGURAL MEETING.

The Inaugural Meeting of the Massachusetts Horticultural Society for the year 1918 was held at Horticultural Hall, Boston, on Saturday, January 12, at twelve o'clock, with President Saltonstall in the Chair.

The call for the meeting was read by the Secretary and the record of the previous meeting was read and approved. The President then proceeded to deliver his Inaugural Address.

Inaugural Address of President Saltonstall.

Ladies and Gentlemen,

Members of the Massachusetts Horticultural Society:

It has been a great pleasure to me to serve as your President for the past two years. It was certainly my intention to retire with the close of last year, but it was represented to me that several of my predecessors had served three years; that it was a year filled with difficulties arising from the war and that under the circumstances I owed it to the Society to continue in office one more year. For these reasons I shall gladly undertake to serve to my best ability although I believe that rotation in the office of the President of this Society every two years ordinarily is advisable.

The past year has been one of great interest to me and I feel that the result of the work of your Trustees and the various Committees undertaken during the year has not only kept up with the

standard of the past eighty-eight years, but in several respects has shown marked progress.

There have been ten indoor shows during the year. These all will be spoken of in the reports of your Committees.

I want to speak briefly of the Spring Show, the June Outdoor Show, the Special Fruit Show, and of the Children's Garden Show.

We started in early last year to make the March Show especially attractive and we employed for the first time Mr. Chester I. Campbell, the well-known publicity agent, to assist in giving publicity to the Show. The exhibit itself was certainly most attractive. We shall carry in our minds for years the impression made by the lovely exhibits of Acacias and Orchids and flowering bulbs and grouped plants. The exhibits were effectively arranged both as to color and varieties and many who have attended our shows for years were enthusiastic in their praise of this Show. It was a Show that stimulated a real interest in a very large number of people. The paid entrances amounted to $7,383.25, a considerably larger amount than was ever received at any one show given by the Society. Our expenses were large but we made a considerable sum, and the thing not to be overlooked is the fact that we reached a very large number of people. I think it may well be referred to as the biggest and the best show we ever had indoors.

The June Show was featured along quite different lines; our Society in its early history had given shows on the Public Garden and Boston Common, the last in 1873. We wished to exhibit some of our beautiful indoor and outdoor plants and shrubs under more favorable conditions than is possible in the Hall and for this reason secured the spacious grounds of the Arioch Wentworth Institute. It is not necessary to mention the great amount of work which was done in adapting these grounds to the rock garden and pond and the outside planting for it is fresh in the minds of all of us.

The seven large tents with their various special exhibits was the most ambitious venture ever undertaken by our Society in the way of an outdoor show.

The exhibits were certainly most excellent. The Orchid Show was worth traveling miles to see, and the same was true of the Azaleas, the Wisterias, and the Roses. For some reason which I cannot explain we had most uncommonly bad luck on weather.

It was very cold and rainy prior to the Show so that the Rhododendrons were far from their bloom, and to make matters worse it continued to rain almost every day of the Show. It was indeed most depressing. If I remember rightly, the one person who could look pleasant during the last days of the Show was our good friend James Wheeler who did his very best to help us out of our troubles.

The Show was not supported by the public and under the circumstances the result was not surprising although terribly disappointing. Great thanks are due to Mr. Walter Hunnewell and Prof. Charles S. Sargent for their exhibits of Rhododendrons, Azaleas, and Wisterias, to Messrs. John Waterer's Sons Co. of England, for a fine exhibit of Rhododendrons, to Mr. Thomas Roland for the Roses, to Mr. John K. M. L. Farquhar for his collection of new varieties of evergreens, mostly the result of Mr. Wilson's collections in China and Japan in recent years, to Mr. Cooley, Mr. Webster, Julius Roehrs Co., F. J. Dolansky, Mrs. Weld, and several others for the Orchids, to Mr. Sim for his Pansy exhibit, and to numerous other exhibitors all of whom exhibited, without expectation of money prizes.

As one result of this effort, I was obliged to call upon 19 members of our Society who had underwritten various amounts in case of a loss and as a result of their generosity our Society sustained a trifling loss although the amount to be paid up was a good large sum, so large that I think it just as well not to mention it. The chances of bad weather necessarily make a show of this kind more of a venture. I am glad that we gave the Show and certainly hope that it may have done some lasting good to our Society. The Show in itself was certainly most creditable, and the Society is greatly indebteded to Mr. Thomas Allen for his efficient services in connection with the arrangement of the same.

At the Fall Fruit Show given in conjunction with the American Pomological Society and the New England Fruit Show in November there was a fine exhibit of apples and a fair exhibit of pears, grapes, and some other fruits. An instructive series of lectures was given during the progress of the Show. Great interest is apparent in the cultivation of the apple but there seems to be a comparatively little interest in the growing and development of the pear. Years ago in this Society there appears to have been more interest in the pear than in the apple.

I happened to be glancing over the report of the annual meeting in 1866 and mention is there made of an award to Francis Dana for the introduction of the Dana's Hovey, to my mind one of the very nicest pears grown. How long is it, I wonder, since anyone of our members has been awarded a prize for the introduction of so good a pear as that!

The Exhibition of the Products of Children's Gardens was wonderfully successful this year. It showed beyond doubt that the children are interested in the growing of commercial crops, perhaps especially stimulated this year by the war conditions. We believe our annual show for children is specially desirable and should be continued from year to year with such variation in program as to broaden the field of activity.

Now for the coming year. It is certainly for the best interests of our Society to continue our efforts to increase the membership. As a result of our efforts last year we secured 83 new members. We have had a considerable number of deaths but our membership roll has increased from 925 to 979 and a large proportion of the new members were life members.

From figures given me by our Secretary, it appears that our membership in 1875 was 1035 and this I believe was the largest membership of our Society. Now we have only to gain 56 more members to pass that goal and I should like to accomplish that result this year. It ought to be easy. Each member ought to be able to propose at least one member. Why, think of it, the list of Fellows in the Royal Society of London in 1914 was 14,400!

The Catalogue of the Library, I am told, will contain not only a correct list of our books but a subject index for flowers, vegetables, and fruits, giving a classified list of all that pertains to each special subject. It is expected that this will be completed during the year.

The Lectures will be continued and the program already published shows an interesting group of various subjects which will be discussed. These lectures are well attended and certainly must be doing a considerable good in stimulating interest in horticulture.

The fact that our country is now engaged in a serious war which is affecting all industries to a greater or lesser extent has led your Trustees and Committee on Prizes and Exhibitions to carefully

reconsider the schedule program for the shows as first proposed for this year.

We planned some months ago to appropriate about $8500 for prizes for flowers, fruits, and vegetable exhibits and to especially feature a vegetable show in the fall by the giving of much larger money prizes than has been customary lately, but we have been forced to reconsider the advisability of this for various reasons.

In the first place, our income is going to be considerably less, less rentals and less bounty from the State and our necessary expenses are going to be higher, e. g. coal $1000.00 more this year than last, so that it is manifestly necessary and advisible to conserve our resources to the fullest extent. Again, the thought has occurred to us that our Society could and should actively assist in some recognized war charity or work for the benefit of our soldiers and as the best manner of doing this we are planning to make all our important shows Pay Shows, to give no money prizes except in a few special cases where money has been given to be awarded in special ways, and to give all the net receipts to the Red Cross or other as well recognized charity.

We are going to call upon our amateur and professional growers and our wholesale and retail flower dealers to actively participate in undertaking to make these shows a wonderful success and in that way to contribute a goodly sum to the good cause of charity. The more you think of this, the more I trust you will be favorably impressed with our purposes, and the more you will be determined, I hope, to make the shows a great success. We may well say to ourselves in what other ways can we assist to meet the serious consequences of war? Already our Halls have been used for the Red Cross for three months rent free for surgical dressings work.

Should we not be considering whether we cannot do more in encouraging the proper planting and growing of commerical crops?

It is all well enough to stimulate the growing of vegetables, but is not a lot of money wasted doing it as it was done last Spring? If done again this spring, should not proper instruction be given in the matter of fertilizers and the proper method of preparing the ground? If with our resources we could start an advanced course of instruction to teachers in this line of work, it might do much good and save a lot of useless expense.

Could we not also consider the advisability of growing intelligently more of our own vegetable seeds and take care ourselves of this industry which in past years has become an important trade to Germany? In this connection it is interesting to read an old advertisement that appeared in the Worcester Gazette, April 3, 1783.

"GARDEN SEEDS.

To be SOLD, by EDMUND HEARD, in LANCASTER, the following assortment of GARDEN SEEDS, warrented of the last Year's produce, viz.
EARLY PEAS early dwarf kidney, and six week BEANS, early stone TURNIP, early Yorkshire, green Savoy, and winter CABBAGE, early Mogul, and head LETTUCE, PEPPER-GRASS, PARSLEY, RADDISH, CELERY, BEET, ONION, CARROT, PARSNIP, summer and winter SQUASH.
CUCUMBER, MUSK MELON, and PEPPER SEED,
also, White BEANS, brought from the Northward, of a superior Quality for planting in Cornfields.

LANCASTER, MARCH 14, 1783."

We all know how unpleasant it is to find that we have failed to secure a good crop on account of poor seed and possibly this could be rectified if our seeds were grown here at home. Certainly we would be more independent in a time of war as now.

Just one more thought which has occurred to me since the war. Some people look upon the growing of flowers as a pure luxury which ought to be given up during war times. Now I do not agree with this thought and I want to tell you why.

First, we must consider the fact that a very considerable number of men have given up their life work to the study and work of floriculture, a science in itself; of these men many are of mature years and are utterly unfitted for other fields of work, and in many cases dependent on their work for their support. Again, it is

important to keep this industry going for those who will wish to return to it after the war.

Second, a vast amount of plant life in greenhouses would be lost if greenhouses should be given up. These plants in many cases have taken years to grow and perhaps could never be replaced.

Third, flowers surely are not so much of a luxury as costly clothing or jewelry worn chiefly to attract the eye, or the many attractive but not necessary fittings of our homes. If all luxuries are to go, flowers must go with them, but when you consider the great amount of happiness and real pleasure that can be given to the sick and the wounded and those confined to their bed, in some cases far away from home, I say that flowers should be the last of all luxuries to be forced out by dire stress of war.

In conclusion, let me say that I have received the helpful cooperation of all officers and committee members for which I am deeply grateful. I have enjoyed becoming better acquainted with them and shall try to know them even better as we go through this year together and shall hope to retain their confidence and their full support.

At the close of the address the annual reports of the officers and chairmen of the various committees of the Society were called for and presented in the following order:

Report of the Treasurer, Walter Hunnewell.

Report of the Board of Trustees, by the Secretary.

Report of the Committee on Prizes and Exhibitions, James Wheeler, Chairman.

Report of the Committee on Plants and Flowers, William Anderson, Chairman.

Report of the Committee on Fruits, Edward B. Wilder, Chairman.

Report of the Committee on Vegetables, John L. Smith, Chairman.

Report of the Committee on Gardens, Richard M. Saltonstall, Chairman.

Report of the Committee on Children's Gardens, Henry S. Adams, Chairman.

Report of the Delegate to the State Board of Agriculture, Edward B. Wilder.

Report of the Secretary and Librarian.

The various reports were separately accepted with thanks and referred to the Committee on Publications for record in the Transactions of the Society.

The meeting was then dissolved.

WILLIAM P. RICH,
Secretary.

HORTICULTURAL PAPERS.

MRS. L. S. CHANLER'S ROCK GARDEN

ALPINE PLANTS FOR THE ROCK GARDEN.

By Mrs. L. S. Chanler, Tuxedo Park, N. Y.

Delivered before the Society, with stereopticon illustrations, June 2, 1917.

Alpine plants are a source of endless interest and pleasure to all who know them. The object of what I have to say today is to try and increase your interest in them, be it ever so little. Undoubtedly, many of you who are devoted gardeners have never felt any enthusiasm for alpines and have perhaps even suspected them of being a foolish fad. That is a normal state for those who do not know these plants. I felt that way myself not many years ago and used to ask my English friends not to show me their rock gardens, as I did not understand them.

It is certain that anyone who commences to grow alpines never gives them up. Their charms and fascinations are endless, and though their flowers are usually to be seen only in the spring their growth of foliage rosettes covered with fat buds in many varieties, or laced over with exquisite white markings, as in the encrusted saxifrages, is most lovely at all seasons, and most alpines are evergreen.

About the middle of September, when the great heat is over, these plants like many evergreens put out new shoots and take on an altogether spruce and lively air. Also, many of them bloom again, not with the rich profusion of early summer, but the few late flowers give all the more pleasure because of being rare. A wonderful lace-like plant which blooms from May to December is *Asperula cynanchina.* You see it here draping these rocks in late October. Here is a closer view of it, and later you will see it blooming in early summer. It has all the soft, foamy effect of gypsophila but not gypsophila's bad habit of blooming only once. Here is *Sedum Sieboldii,* also in October. It is a lovely gray and pink plant, and the flowers last a long time.

Gardeners have sometimes objected that our summers are too

hot to grow alpine plants successfully, and this is truly our greatest difficulty. If it is possible to place a rock construction facing north, then our chances of success are greatly increased. But, though our summer sunshine is too ardent, our winter snows are of the very greatest benefit to these little plants. During the winter before last, when my garden in Tuxedo was under a nice blanket of snow for nearly four months, not a plant was lost in the rock garden. Of course, in this country we also sometimes have open winters, but never the warm green Januarys they often get in England, which excite the plants into premature growth and result in many flowers being destroyed. In Tuxedo we have only one plant which has such an early habit that it always starts blooming before Christmas. That plant is *Erica hybrida*, a variety not unlike *Erica carnea*, but daintier, quicker-growing, and with much paler flowers. This picture was taken in October. The buds, of course, increased in size during the warm, sunny days of November.

For all the gray and woolly alpine plants our climate is far better than the English, and we constantly read in the books by Farrer and Robinson about gray-leaved plants damping off and needing the protection of a piece of glass to keep off what they call their rotting rains. A case in point is *Androsace sarmentosa*. A friend brought me a plant of it from Switzerland, and this is what I read about it in Robinson's "Alpine Plants": "This is a Himalayan species, growing at an elevation of over 11,000 feet. The flowers, borne in trusses of ten to twenty, at first sight resemble those of a rosy white-eyed verbena. Like many other woolly-leaved alpines, this is difficult to keep alive through our damp winters. A piece of glass in a slanting position about six inches above the plant preserves it. Care should also be taken to put sandstone, broken fine, immediately under the rosettes of leaves and over the surface of the soil, to keep every part of the plant, except the roots, from contact with the soil. A dry calcareous loam is best. Where limestone can be had to mix with the soil, a much better display of flower and foliage can be obtained. It also helps to keep the plant dry in winter."

So we gave it a dry, well-drained, sunny place, and now this androsace has spread like magic. No pieces of glass could be put

over it, and it needs none. Now it has been divided, and we have dozens, and it has most amusing ways. In the autumn, the outer leaves of each rosette disappear, and the center, which is where the verbena-like flowers are to come, puts on a lovely, gray velvet surface. In June, after flowering, this plant puts out runners like a strawberry. In this picture, the first bit is in bloom in a warm corner between the rocks. Here are the flowers more in detail. They are a pretty shade of pink.

We now have fourteen varieties of androsace thriving, and they vary from *vitallina*, which is only one inch high and golden and easy, to *foliosa*, which is nearly a foot high. These plants have all proved hardy and even easy with us, except *Androsace lactea* and *Androsace villosa*. These two kinds are very tiny and grow slowly. *A. villosa* came through last winter without turning a hair and bloomed beautifully. *Androsace carnea* is a beautiful dark green moss, one inch high, on which appear in April the loveliest rosy flowers. This does better with us than in Mr. Correvon's great alpine collection in Switzerland. It likes leaf-mould and hates lime, and it has even sowed itself. All the androsaces have interesting and beautiful foliage. In some, it is like the tiniest imaginable juniper; in others, there are gray rosettes like house-leeks.

In addition to the many charms and beauties of alpine plants, I feel that they will be of special interest to Americans, because they can be grown without employing a gardener. Wages are already so very high here that only the rich can hope to afford to pay them. Yet there are thousands of flower enthusiasts who would like to garden, if they thought it could be done without much labor or expense. Once reasonably made, a rock garden can be kept up by a woman, even if she is not very strong. Weeding is the principal work, and has to be done carefully and patiently. But as the rock plants are usually grown on a slope or bank, the gardener is not forced to stoop and tire her back. We have rattan seats of different heights, which are kept out of sight, and are most comfortable for weeding. The only other work in a rock garden consists in watering, planting new plants, and saving and sowing seed. This question of sowing seed we will consider a little later.

There are two principal modes of constructing a rock garden. A miniature valley, that is the soil dug out four or five feet and banked up on each side, or, if there is a natural slope, stones laid firmly in it to form irregular steps or shelves, where the plants may be put. Both plans are equally good. In the Botanical Garden at Kew, London, they have the sunken path with high banks on each side, and at the Horticultural Society's Gardens at Wisley, one hour's drive south of London, a big hillside has been used to make shelves and steps, and so show off a great collection of alpines. Here it has been easy to have a waterfall. At Kew they have just a pool next the path here and there. No cement has been used in these constructions, and it has not been found necessary. Cement may be used in retaining walls, as will be shown when that subject is reached, but for a rock garden the weight of earth is usually not too great to be held up by well-placed stones without cement; of course, large stones two or even three feet long are used for the foundations.

For a very small rock garden the bank seems easier and more suitable, but in my own rock garden I have made the little valley which has the advantage of banks facing north and south. Unfortunately, the bed rock was so near the surface soil that we could excavate only about one foot.

It is extremely important to build with solid foundation and a definite plan. The idea that any natural-looking mound of stones heaped together will do for growing alpines is a hopeless mistake, because the plants must have definite and solid protection for their roots. Mr. Farrer says: "Stone in nature is never disconnected; each is always, as it were, a syllable in a sentence. Remember that, urgently: boulder leads to boulder in an ordered sequence." There must be no cracks, air-spaces, or slipping down of the soil. These are absolutely fatal, and it is a thousand times easier to guard against them in the original construction than after a number of plants have started to cover the stones.

When one has decided on a rock garden and has got the stones and earth together at the chosen spot, there is an almost overwhelming temptation to build too quickly, and to put in what plants one has, for the sake of seeing the effect. This is a most dangerous way to proceed. We have suffered from it for years, and have lost

valuable plants in painful efforts at reconstruction. It is all a question of considering the roots of the plants. If they are planted on a slope with nothing much to hold the soil, it is bound to wash away in our heavy rains, and then roots will be uncovered, and plants will die. Alpines, though often less then an inch high need deep earth for their roots. Robinson says these tiny plants often have roots a yard long. Nothing is more certainly fatal than to plant them in a pocket with no depth. They may thrive for a time, but after the first drought, they die.

The pockets or shelves where the plants are to go should not slope down toward the path. They should slope back a little toward the main construction to carry the rain into it. This is hard to achieve, because after the stones are fixed and the soil is in, one adds sand or fertilizer or lime, and, the whole shelf being small, the least addition to the soil will result in the wrong slope. Usually, it occurs in the very beginning, when the soil is being shoveled in. So the builder must not hesitate to take out earth until the levels are perfect. Here are pictures to show the difference: although the quaker ladies looked lovely on the wrong slope, that was only for one year, before the earth had had time to wash away. Also they are the most accommodating of ladies, besides being very lovely. In the second picture, flat shelves can be seen, where the plants can be perfectly happy. This picture shows a well-placed rock in the foreground. It is almost bare, because it has only just been put in, but the shelf or tiny terrace which it holds up, shows well what is meant by a proper level. On the left of the picture, the wrong kind of slope is plainly seen. This has been taken out, and flat pockets put in its place.

In arranging the rocks, care should be taken that none are allowed to overhang. This would prevent the necessary rain reaching the plants underneath the rock. Every part of the rock garden should be so arranged that all the rain will be absorbed by it.

Beside the absolute necessity of making the roots of the plants secure against all disturbances, and the length of the roots must be seen to be believed, the general effect is far better and happier if the levels are made right. It is all the difference between a reposeful picture and a restless one, slipping down, or everlastingly fixed. In this picture, the flat shelves are seen on the left, and on the right

there is a sloping bank, now happily made flat. It must constantly be remembered that the plants and not the stones are the main point in rock gardens. The stones are merely the frame and must be kept from intruding into the picture.

What Mr. Farrer means by "Boulder leads to boulder in an ordered sequence, and treating your rocks as syllables in a sentence to make a coherent whole" is well illustrated in this picture. Several of the stones are disconnected, with the result that water has evidently washed soil from precious roots. Therefore the place is half bare. It will also be noticed that the few plants doing well are the ones with the stones protecting their roots from disturbance.

For the amateur, simply wishing to experiment with the more easily grown rock-plants, so as to find out if he really has a taste for this form of gardening, the sloping bank in which half a dozen stones are partly buried, will do perfectly well as a beginning. It is far easier and pleasanter to begin modestly and gradually expand, than to lay out an ambitious rock work and then find that one has neither the skill nor the inclination to grow the right plants for it.

The bank shown here was only partly devoted to growing alpines; next spring, however, the rocks will be extended, and the annuals will not be there. Of course, there must be no formality about anything in the rock garden, no grass edges or anything of that sort. We do not need the stepping stones so useful in damp England, but a gravel path is useful, and dwarf plants often seed themselves and thrive in it. There is more moisture in the path than anywhere else, as the water is sure to trickle down. So, even though the path plants do occasionally get stepped upon, they are often very handsome.

The whole surface of the rock garden should eventually be covered with plants, but one must be cautious, as some undesirable kinds are too free and are hard to get rid of. It is best, for a time at least, to submit to the ugliness of bare ground than to let one's precious pockets be over run with greedy, seedy plants. This bare ground about rare plants should be covered with small stones or broken rock to prevent evaporation, and they would also prevent stagnant moisture in winter. The stones are not pretty, and

a little soil sprinkled on top of them makes them less conspicuous. When our object is achieved and we have collected enough of the best plants, there will be no bare, stony places to offend our eyes. Here is one approach to the rock garden. Nothing in the least formal, and low plants are better than high ones. These forget-me-nots were glorious, because just beyond them, looking black in the photograph, was a solid mass of that wonderful hardy wall-flower, *Erysimum allioni.* As far as I have been able to discover, there is only one shade of it, a deep rich yellow. It is biennial and grows about a foot high. Here are more forget-me-nots. These are with lilies-of-the-valley, and the whole plantation is surrounded with periwinkle. In the periwinkle we plant that typical alpine, the autumn crocus. I have often smiled as I read about its charms for the rock garden and wondered what these good authors thought of their autumn crocus in May, when it's great coarse leaves appear. By growing them in the periwinkle we are able to hide these leaves as soon as they show signs of drying. We roll them up and hide them under the periwinkle, and there they can dry up without being an eyesore. Here are the crocuses in September.

Visitors, seeing a rock garden for the first time full of blooming alpines, are constantly exclaiming, "These cannot be hardy plants! They are too delicate, too brilliant to have lived all through our icy winters." These *Saxifraga cordifolia* were particularly brilliant last April, a vivid coral pink, and you can see in this picture that there were no leaves on the trees when they bloomed.

Here is another alpine beauty, a *Primula denticulata cashmeriana.* It sows itself, and, given half shade and water during dry weather, it is perfectly easy to grow.

The old-fashioned way of having gardens bare in the early spring, except for narcissus and tulips, has resulted in their being accepted so, as a natural law, and when people hear of twenty or thirty varieties being in bloom in early April they are amazed.

Alpine plants usually bloom in the early spring. In the mountains the summers are very short; often only a few weeks from the time when the snow melts to the first storms of autumn, so the flowers must appear immediately, if they are to ripen seed and continue their species. There are summer-blooming alpines like

the large and lovely family of Campanulas, but, though the *plants* are perfectly hardy and easy to grow, the *flowers* do not survive our July sunshine very long, so that visitors, seeing a rock garden after June, may well be disappointed over the lack of color and brilliance. *Linum perenne* is a lovely summer-flowering plant, rather large perhaps, but the blue flowers succeed each other for a very long time, and the foliage is soft and graceful. These alpine pinks bloom all through June and are the greatest joy because of their fragrance. Their foliage is always an addition, being soft mats of that gray green shade which is so becoming to all flowers.

Here are more June flowers, *Campanula longistyla*, a biennial like the Canterbury bell, but a real beauty and easily raised from seed. The little white flower above is *Silene rupestris*, one of the easiest plants to grow and always an addition wherever it sows itself. The lower white flower is *Arenaria montana*, not at all easy with us, but in the shade it consents to thrive. Above is the foliage of the *Saxifraga cordifolia*, which you saw a few minutes ago.

In April, May, and June, there are always masses of flowers in the rock garden, and the early flowers are after all the ones we enjoy most, after being deprived of them all winter long, and before the heat in the mornings and the mosquitoes in the evening drive us indoors.

Another very important reason why rock gardens should become known in this country is that a rock garden can be made on the smallest piece of ground. My own rock garden, which already boasts of over 350 varieties, is only about 13 yards long and 8 yards wide.

Mr. Reginald Farrer, in his charming book "The Rock Garden," says it is really by far the cheapest and most graceful form of gardening. "It has become, and is hourly still more universally becoming, the pet passion of the man who has small means and only a small plot of ground to play with." And this in England, where labor was so cheap.

Position.

A rock garden does not look well in a landscape or near the formal lines of a building or a road, and it should be put in a secluded

corner, where it can be nursed and enjoyed intimately. The late owner of Holland House, London, was so fond of alpines that he planted small groups among stones on either side of the garden door of that magnificent Elizabethan Palace, where they looked entirely out of place.

The suburban home should have a bit of ground at the back, if its owner wants a rock garden. Stones are bound to look irregular and inharmonious in formal surroundings, as can be seen when rocks are left in a lawn. Harmony with surroundings is the fundamental law of successful gardening.

In a rock garden, one can get closer to nature as she shows herself on the mountains, than in any other way, if one has not the land for woods and streams and pastures. Alpine plants are practically all perennial, permanent, and stationary, not popped in out of a greenhouse only to die in the first frosts. These temporary plants have no individuality, no opportunity to adapt themselves to their surroundings, and though they may be beautiful, they are not interesting. Alpines take time to develop, and show their true character, but once they do this, the happy owner, who has given them their chance, can feel that he has real nature to enjoy, something superior to the learned combinations of the landscape gardener.

As has been said, the rock garden does not look well near a building. But in the back yard of a suburban plot, a rock garden will transform into an actual source of pleasure what is usually the dullest corner.

It is essential to put the rock garden in an open situation and not under the drip and shade of trees or overhanging and greedy shrubs. Shade from a building or wall would do no harm, if it were only for half the day, and it is a great help with our tropical summers to have at least part of the rock garden facing north. Many plants, such as campanulas, mossy saxifrages, and androsaces (rock jasmin) do better in half shade, and the flowers last longer when not exposed to long hours of sunshine. In a small place, if it is found necessary to put the rock garden near a tree, whose roots would be sure to come after the good soil provided for the alpines, a small wall descending as deep, or somewhat deeper, than the roots of the tree, and made of rough concrete, would be a great help in keeping the tree roots in their place.

Edgings.

A rock construction is not by any means the only place in which alpines may be grown with pleasure and success. The larger and more easily grown varieties can be very effectively used for edging plants, and as most of them are more or less evergreen, they look extremely well in that position. Edgings are very important, and a beautiful border without a satisfactory edging is about as pleasing as a beautiful dress without a collar. In Europe, where turf and lawns are very much at home because of the damp climate, and where labor is so cheap, grass edgings are commonly used, but here lawn grass is not at home. It is an artificial and highly expensive decoration, and if it is in narrow strips with edges, which must be constantly trimmed, it hardly seems worth the trouble and expense it costs, especially as it is brown and ugly for nearly half the year here, while in Europe it is always green.

Near a building, as has been said, formal lines are necessary. In such positions cut stone edgings look well and hold up small plants perfectly. Cut stone edgings are expensive, but the expense ends when they are bought. The clipping and trimming of grass edgings never ends. For the greater part of the garden, native stone partly buried and carefully chosen to look more or less even in height will serve perfectly, and as one wishes to cover the edgings with flowering and often evergreen plants, minor irregularities in the stones are soon hidden. Many varieties, such as the evergreen candytuft, double arabis, *Dianthus deltoides*, and *Dianthus plumarius*, forget-me-not, *Campanula carpatica*, *Alyssum saxatile*, etc., etc. do splendidly as edging plants and these are too easy and free growing for the rock garden. They nearly all seed freely and would be a danger to tiny plants one or two inches high. While the rock garden is new, and before many plants have been gotten together, some of these coarser plants could be carefully used on the less desirable parts of the construction, the highest part for instance, which is the most exposed to heat and cold and drought. But care should be taken not to allow them to seed down among the treasures.

Some people think *Oenothera speciosa* a suitable rock plant, but though lovely as edging for a herbaceous border, it is far too free

and vigorous to plant among alpines. Heather, on the other hand, can well be used in both ways. For a formal edging near a house *Erica carnea* has no rival, where box is not hardy. It can stand any amount of winter sun if a few evergreen branches are put over it from December to April, and it can be clipped into a formal shape and is never more than six inches high. Its greatest quality, however, is in the flowers, and the picture shows how freely these are produced. The buds form in September and are plainly to be seen all through the winter, while in April, after the first warm day, they burst into bloom, a lovely warm pink. After a couple of weeks, the flowers turn magenta and are less pretty, but if one is careful to have no clashing color near, they are a joy for nearly a month, and all this during terribly cold and often snowy April days. They are often seen blooming bravely through two inches of snow and seem none the worse when the warm spring sun melts it away. In the rock garden, they are just as valuable.

The same rule applies to these stone edgings as to plants in the rock garden proper, the stones protect the plants from drought and frost and give them a chance to show off their flowers to the best advantage, especially if the stones are gray and the flowers pink.

Wall Gardens.

In laying out a place, if it is larger than a small suburban plot, there are usually slopes more or less steep to be dealt with. These are often ignored, treated as if they were flat, and planted with grass, shrubs, and trees. If the slope is at all steep the water drains off it too fast to allow grass to be green very long in our dry summers. Then one often sees trees and shrubs look as if they were slipping down these banks. Nothing is less reposeful or less satisfying than this effect, and it is far better to face the fact of the slope in laying out the place, and to put in retaining walls. If several such walls are used, one below the others, small terraces are formed, such as one sees in Switzerland and in Italy, and these give far better foothold to whatever plants one desires to grow than a sloping bank with the earth continually washing away from the roots. It is the same principle which we

were considering in the construction of the rock garden. The reader has only to look about his neighborhood to see the slipping down effect of trees and shrubs, and how poor the grass is on a sunny bank.

If, to avoid this, retaining walls are put in, a new field for the planting of alpines appears, and we come to what in England is called Wall Gardening. There dry walls are used. In this country, a dry wall, meaning a wall built of stones without cement, gets pushed out of shape by our frosts and looks in time like a wall in a nightmare, not at all a suitable border for a road or decoration for a lawn. Miss G. Jekyll and other English authorities recommend dry walls most highly, but they have very little frost to contend with. In this country one can manage by having the wall thoroughly cemented at the foundations and for eighteen inches from the ground. Then, if half the other stones are made fast with cement, say roughly every alternate square foot, the other half may be planted and will give an excellent effect, probably quite as good as if it were entirely covered with plants.

It is very important in making such a wall to watch the men constructing it, otherwise they will throw in large stones, instead of earth mixed with small stones, behind the wall. The whole idea of a dry wall is that the plants should be able to root through it into the bank of earth behind. If, when the tender roots push back, they find only stones, the plants will naturally die. It is necessary to enrich the soil and see that it has humus well mixed with it, so that the plants can thrive. In building the dry wall, as much care should be taken to ram down the soil and leave no air spaces as in constructing the rock garden. It is really the same idea, and it is also necessary to have the stones tip upward a little, so that the rain may reach the plants between them. This is called a battered wall and can be done by putting small stones between the front of larger ones and carefully filling and ramming the crevices between the soil. When finished, this should all be perfectly firm.

Many and varied are the plants which can be grown in the retaining wall, and if it faces north our native plants, such as ferns, columbine, the small two-leaved Solomon seal (*Smilacina bifolia*), and violets, with a few harebells, would make a lovely

picture. It is best, as in all gardening, to put a good-sized group of one variety before going on to plant the next. A confusion of several kinds jumbled together would probably look about as artistic as the bouquets thrown into carriages by peasant children abroad. A wonderful help can be had from gray-leaved plants, and among rock plants their names are legion: alyssum, arabis, achillea, artemisia, *Stachys lanata,* and cerastium, to mention a few of the easier kinds.

The common way of repeating the same plants at intervals along a wall is as fatal to the picturesque or natural effect as it is in the herbaceous border. It must have originated in the entirely unimaginative mind of a hard-working gardener, who thought much more of growing plants by the hundred than of observing the ways nature had with them. Nature usually plants in groups and never in rows, let it be noted by the way.

Mr. Robinson says there are many alpine plants now cultivated with difficulty in frames, which any beginner may grow on walls. Now that is certainly encouraging to the beginner considering a wall garden, and then it is such fun to see the delicate and lovely little jewel-like plants so close to one's eyes.

If the retaining wall is not too high, a delightful opportunity is offered by its flat top. In this picture, *Cerastium tomentosum* can be seen draping the top of a low retaining wall, and it makes a pretty fringe or edging for the upright-growing irises. Here is the cerastium not yet in bloom. You can see how it grows between the stones.

Growing Alpines from Seed.

It has been mentioned that among the four principal considerations in keeping up a rock garden are the saving and sowing of seed. This seems to be a job particularly suitable for women. It requires some thought and a good deal of time, as it is very necessary to collect seeds at the right moment, when they are dry, and before they begin to drop, but it is not tiring or hard work, and it is very interesting. All the authorities agree that the best and healthiest plants are those raised from seed, and one's own seed

is the freshest and most amusing to deal with. In this way, one is constantly improving the different varieties by only saving seeds from the best specimens of a given kind.

At present and until the public demands more of the dealers, seeds of many of even the most easily grown varieties must be imported. Fortunately this is easy, not at all like importing Paris gowns, and Mr. Correvon has all the varieties in cultivation for sale at very low prices. There are about six thousand different kinds of plants mentioned in his general catalogue, and nine-tenths of these have been raised from seed at Geneva and are therefore acclimated to low altitudes. It has been our custom to import and sow about fifty varieties each winter, getting them into the ground as soon as possible after New Years. We sow the larger varieties in cold frames and the smaller and more difficult ones in pans or pots, plunged in earth in the cold frames. After sowing, the seeds are covered with snow, as Mr. Correvon says it helps them to germinate. He recommends soil composed of one-third peat, one-third loam, and one-third sand, granitic or lime rubble, according to the variety.

One of the keenest pleasures of the alpine gardener is to visit this frame in the spring and see the hundreds of little new treasures at his disposal. Many, of course, have not come up in such a short time and must be kept over sometimes for another year before they germinate. In that case it is best to remove them to a half-shady place, for if the tiny plants should appear, they might be burnt up during one scorching day in July.

Freshly gathered seed germinates very much more quickly and surely than old seed, so it is best to sow the seed we save ourselves as soon as possible. This also results in the plants making a good show of flowers the following season. After collecting seed from the early-blooming alpines, we usually make a first showing in June, then in July other varieties will have ripened their seed, and we sow again. Some are sown in the open ground, the sturdier kinds like the mountain pinks, *Lychnis flos-cuculi* and columbines; others, smaller and more delicate ones, are sown in the cold frame. The ripening seed looks untidy, and there is one owner of a beautiful rock garden who never allows any seed to ripen. But, until one has enough of a given variety, it seems so much more reasonable

to save and sow the fresh seed than to keep on buying plants. After a couple of years, one could grow a few plants in reserve, solely for the purpose of getting seed from them.

A good deal of leaf mould or humus helps seed to germinate, as it keeps the soil open and porous.

Advantages over England.

We have all heard and read a great deal about the enormous advantages of gardening in England. After gardening there for ten summers, I have come to the conclusion that if the same amount of skill and time were spent here as is spent in England on gardens, we should have very nearly as much garden beauty as they have. Not the same beauty of spreading lawns and hedges of holly and yew, but wonderful flowering trees and shrubs, which either cannot be grown in Europe, or present miserable objects with very few flowers in English gardens. Our glorious laurel I have seen there languishing in pots, and taking into consideration its many and wonderful beauties, there is surely no European shrub to compare with it. Our native rhododendrons and azaleas are also plants of incomparable garden value. In England, beds of peaty soil are made, in which these plants, with some of our andromedas, huckleberries, and lilies, are grown, and as there is difficulty about making them thrive, they are very greatly admired. Here, on the contrary, people worry over box, English ivy, tender retinosporas, and other European varieties, instead of giving a proper place and setting to our own plants.

From lack of knowledge and imagination, European plants and methods have been used in this totally different climate with deplorable results, and vice versa, American plants abroad are often far from being beautiful.

But, if the choice of suitable plants has a great deal to do with poor gardens in America, the lack of trained helpers in gardens has a still more unfortunate effect. A trained gardener gets five or six times the wages here that he is accustomed to receive abroad. And then, who does he have to help him? Instead of under-gardeners, hoping to rise to be heads in their turn, and trained in

garden work from the time they were small boys, he has usually to put up with Italians fresh from working on a railroad track or in an iron foundry. These men often speak little English and have absolutely no knowledge of plant life.

Where there are greenhouses trained helpers are usually found, but in a hardy garden one gardener with men accustomed to the roughest day labor are customary. Now how can it be supposed that beautiful gardens can result from this system? The head gardener is only human, and if he is obliged to do all the planting, sowing of seed, handling of seedlings in their various stages, moving of trees and shrubs, has to remember about all the watering, and pick vegetables and flowers, it is obvious that very much must remain undone.

This situation is also made far worse by the fact that, owing to our hot summers and cold winters, more than one-half of the most important planting has to be done in May. In April, the ground is usually sticky and wet from melting snow, and in June it is too hot.

It has also seemed to me that head gardeners as a rule feel they have done their full duty, if only they can produce in a greenhouse roses and carnations as large and stiff as the average florist has for sale. They are often unashamed of the most deplorable looking borders.

When rich people here learn to care for hardy flowers as they are cared for abroad, our gardens will be just as beautiful, only they will not be so numerous, because the high price of labor makes them impossible, except for the very rich.

This is why I have talked against lawns and clipped edges. If our one and only gardener spends his time tending them, he cannot be growing new plants, however simple their cultivation may be, and it is by continually sowing new seed and adding fresh beauty that our gardens remain interesting.

THE ARNOLD ARBORETUM.

By Edward I. Farrington, Weymouth Heights, Mass.

Delivered before the Society, with stereopticon illustrations, January 12, 1918.

"For a thousand years and then another thousand years, and so on forever," reads the solemn agreement by which the City of Boston enters into contract with Harvard University to care for and perpetuate the Arnold Arboretum in Jamaica Plain, undoubtedly the greatest tree museum in the world. Curiously enough, the great majority of people, even in Boston, know nothing about the Arboretum or its purposes. This is distinctly unfortunate, for the loss is not the Arboretum's, but that of the public which should profit by its work and enjoy its beauty.

Expert landscape gardeners and nurserymen know the Arboretum as a clearing house of knowledge. They use it. The Arnold Arboretum is the only place in this country where data on the comparative hardiness of woody plants covering a long period of years can be found. Perhaps if the Arboretum were not so modest about tooting its own horn, it would receive greater credit for what it has done. Within its borders nature is working miracles which must have a profound effect on all gardens of the future. Every fruit grower has an interest in the Arboretum. Future years will yield finer Apples and Pears and Peaches than any you yet have tasted. They may come from crosses with Chinese trees introduced by Arboretum explorers.

We know little so far about the possibilities of nuts as a food. Yet the time may come, and before long, too, when the whole world will be eating nuts. Practically every nut tree which will grow in this climate is now to be found in the Arnold Arboretum.

As for its value to the home gardens of the country, nobody can estimate it. Every plant brought from foreign lands — and they number thousands — if suited to this climate, is tested and re-

ported upon in the Arboretum trial grounds. In this way the people of the country are protected from losses and discouragements. Where else can the public learn the secrets of the Rhododendrons, the eccentricities of the Azaleas, the varied habits of the Viburnums, and the unexpected values of the Lilacs?

How are all these new things obtained? A book of romantic adventure might be written in answer to that question. Plant hunters sent out by the Arboretum have penetrated to corners of the world where the foot of a white man has never trodden before. The most famous of these plant hunters is Ernest H. Wilson, who has given hundreds of plants to the world through the Arnold Arboretum. How he rolled down a mountain side in western China and lay for weeks in a mission hut is now a well-known story. Among the most notable plants introduced by the Arnold Arboretum are *Azalea Kaempferi*, the tree Lilac, the Sargent Cherry, the climbing Hydrangea, and the Japanese Barberry.

The Arboretum had its origin in the imagination of George B. Emerson and the generosity of James Arnold. Mr. Arnold, a New Bedford merchant, left $100,000 to be used for horticultural and agricultural purposes. Mr. Emerson was one of the trustees in charge of this fund. He it was who formulated the plan by which Harvard University took the bequest and turned over a part of the Bussey farm for an arboretum in which every tree and shrub suited to this climate should be grown. Later an agreement was made with the city of Boston whereby the latter contracted to lay out a system of walks and drives, police the grounds, and pay whatever taxes might be levied. In return the Arboretum was made virtually a part of the park system. This great tree museum now occupies 220 acres of hill, valley, and meadow.

For the most part the trees have been arranged in family groups so that they can be studied to the best advantage. Single individuals of the native trees have been planted far enough away from the groups to make possible their full and free development.

The Arboretum is designed for serious study, yet everywhere the attempt has been made to group the trees and shrubs in such a way that the natural features of the trees may be preserved. Much can be seen by walking or driving around the public roads, but much is also missed. The only way to get all that the Arbore-

tum offers is to leave the main drives for the grass covered paths which lead to the smaller groups. With map at hand, it is an easy matter to locate any general group of trees and shrubs. Yet many of the foreign plants now on trial do not appear. Coming down Bussey Hill, for example; at this point there is a fine collection of Chinese shrubs and close by the celebrated Cedars of Lebanon.

The gates of the Arboretum are open from sunrise until sunset. Everybody is free to enter. You can spend an hour or a day there, with profit and with pleasure. Take your luncheon and eat it on the grass under the waving trees if you care to do so. Follow the grassy paths; they lead to unexpected beauties. You will find every tree and shrub tagged with its right name. Take a note book along and jot down the names of such plants as you would like in your own garden. If you want any special information, stop at the Administration building near the Jamaica Plain entrance, and it will be given you.

This building was erected for the Arboretum by the late Horatio Hollis Hunnewell, whose garden and pinetum at Wellesley are known to all students of trees. Here are thirty-two thousand bound volumes, together with many pamphlets, constituting a library of incomparable value. The herbarium is believed to be the richest and most complete collection of material representing the coniferous plants of the world which has ever been made. It contains also a collection of the woods of North America. The dried specimens are stored in fireproof metal cabinets, and all are so carefully indexed that any one among the hundreds of thousands can be located in less than one minute.

In one corner of the upper floor of the Administration building is the office of Professor Charles S. Sargent, the first and only director of the Arboretum, and the man most responsible for its development. It was Professor Sargent who nursed the institution through its early days of stress and trouble. Nothing but his enthusiasm could have withstood the depressing public indifference and the lack of expert cooperation. It was a big task to lay the foundations of an institution which is to last two thousand years and so on forever. His wisdom and foresight have made it what it is today. His monument has been erected while he yet lives.

The natural way in which interesting specimens are displayed is to be found on the boundary walls, where hardy vines are trained. Not only are the vines themselves offered for study in this way, but the manner in which they can be used to the best advantage is shown. Professor Sargent takes particular pride in the Grape vines growing on the walls, for in his opinion many people fail to realize the decorative qualities of these vines. The Bitter Sweets and many other native vines are also grown.

The only formal planting in the Arboretum is to be found in the shrub garden, near the Forest Hills entrance. Here hardy shrubs in great variety are arranged in parallel beds on the only piece of level ground which the Arboretum boasts. These shrubs have been so placed that the visitor can easily compare all the species of any genus in a short time. In this way he is able to select the particular variety which he may want for any particular purpose. Unfortunately, the space which can be devoted to this collection is too small to contain all the shrubs which can be grown in the Arboretum. The Dogwoods, Rhododendrons, Viburnums, and the like, will be found in other places, usually near the trees to which they are related.

The shrub garden contains probably the best collection of wild Roses in the country.

Among the Roses now growing in the shrub garden, *Rosa multiflora cathayensis* is of particular interest. It is the Rose from which sprang the Crimson Rambler, which has long been cultivated by the Chinese and came to this country by way of Japan and England. Likewise it is the progenitor of the Seven Sisters Rose, which used to be common in country gardens. This Rose is established in the Arboretum, flowering and ripening its fruit every year.

Rosa Hugonis or Father Hugo's Rose was found by a missionary in China and came to this country by way of England. It promises to prove a splendid Rose for New England gardens, being perfectly hardy and bearing oceans of yellow flowers which are set so closely on the branches that they touch. It is a pity that the Arboretum has no room for a complete Rose garden, where every species, variety, and hybrid, old and new, might be cultivated. There is genuine need for just such a garden somewhere and the Arboretum already has a nucleus. How better could any wealthy man

perpetuate his name than by providing the Arboretum with the means of establishing a real Rose garden, such as exists nowhere else in the world.

Some years ago Mr. J. G. Jack, of the Arboretum staff, visited the far East, and although he spent only a short time in Korea, he discovered several interesting new plants, among them *Diervilla florida venusta*, perhaps the handsomest of all the species, varieties, and hybrids of the Weigela. It is a shrub which grows five feet tall, and in Spring is completely covered with dense clusters of rosy-pink flowers from an inch and a half to two inches long. It is perfectly hardy, too, which cannot be said of all the Weigelas. It grows rapidly, and no shrub known bears larger crops of flowers. It is one of the purposes of the Arboretum to search out the best varieties among the different shrubs, testing them for hardiness and reporting on their availability for northern gardens.

Repeated tests have shown that many of the Deutzias, handsome as they are, are not suited to cultivation in New England. It is not often that plants are actually killed, but they are frozen back so hard that they do not bloom. *Deutzia parvifolia*, *Deutzia crenata*, and a few others are known to be perfectly hardy. Several Deutzias from western China are now being tested in the Arboretum, and it is hoped that some of them will prove valuable additions to New England gardens.

The Arnold Arboretum has the largest and most complete collection of Loniceras, or Honeysuckles, in the world, just as Mr. Rehder, of its staff, is the leading Lonicera expert in the world. *Lonicera Korolkovii* is a shrub of peculiar elegance. A bush Honeysuckle with grayish leaves is a novelty. At times this gray is so intense as to be almost blue, while again it is nearer green. View it in the morning when covered with dew, and it looks as though encrusted with a kind of enameled jewelry. Many different Honeysuckles have been tested out at the Arboretum, climbers as well as those having a bush form. Among the newer arrivals is *Lonicera Henryi*, one of the few evergreen climbers hardy in this climate.

Sorbaria arborea is a discovery of Mr. Wilson's. It's a charming shrub if given planty of elbow room. As a matter of fact it will insist upon having all the room it needs, because it just naturally

moves out and smothers anything in its way. The bloom of *Sorbaria arborea* comes along in June, and lasts through most of the Summer. There is an early burst of bloom, but it is seldom that a large number of flowers are open at one time. They make a floral procession which is as interesting as it is pleasing. Judging from the specimens in the Arboretum, this is not a particularly good plant for small gardens, but is excellent for use on large estates.

There would be fewer disappointments if amateurs in general would choose some other variety of Privet than the common California Privet when planting a hedge. There are some sections where California Privet thrives, but in the North it is very likely to be badly winter-killed. If you will visit the shrub garden at the Arboretum you will find half a dozen varieties growing side by side, and can study them at your leisure. Most of the Privets have attractive blossoms if they are not kept trimmed, while in the Fall they yield a profusion of black and blue berries. *Ligustrum Ibota* is a most desirable hedge Privet for this section. It is also attractive when grown as a specimen or in mass planting.

Among the plants introduced by the Arboretum from central and western China, through the explorations of Mr. Wilson, none give greater promise as garden plants for the North than some of the Cotoneasters, of which twenty species and varieties are now established here. *Cotoneaster hupehensis* is a species with very showy flowers and is perhaps the most worthwhile shrub for northern gardens which Mr. Wilson has brought back from the far East. It is handsome in the Fall as well as in the Spring, for then its branches are covered with scarlet, lustrous fruits. Several of the Cotoneasters grow six or eight feet high, while others form dense mats of prostrate stems, but nearly all have dark green and very lustrous leaves, which retain their color until the late Autumn. Besides the collection in the shrub garden, there is another containing the newest Chinese Cotoneasters in a long bed on the southern slope of Bussey Hill.

Spiraea nipponica or *bracteata* is a particularly handsome and hardy Japanese shrub, which is not known in American gardens as well as it should be. The family of Spiraeas is a very large one, and the amateur finds it difficult to choose intelligently among the varieties offered by nurserymen. It will help greatly to make a

little study of the plants found in the Arboretum collection as they come into bloom. You will find that some of the least well known are among the best.

An unusually good specimen of the climbing Hydrangea, *Hydrangea petiolaris,* is to be found growing on the brick wall of the Administration Building, to which it clings as firmly as Ivy. This is also a Japanese plant, and the only climbing vine with conspicuous flowers which can be grown on a wall without artificial support in the Northern States. It can also be used to climb up the trunks of trees, and individuals seventy or eighty feet high are not uncommon. Its value as a wall covering is increased by the early appearance of dark green leaves, which are nearly full grown before there is a sign of a leaf on any of the Virginia Creepers.

Magnolias are among the showiest of flowers, and several varieties have been planted around the Administration Building. *Magnolia macrophylla* is one of the most interesting species. It has the largest leaves and the largest flowers of any tree which grows outside of the tropics. The leaves are over thirty inches long, and eight inches wide, while blossoms a foot in diameter are not unusual. These flowers are creamy white, fragrant, and with a very deep cup. They may be called without exaggeration nature's lodging houses for the rose bugs. I have tipped up one of these blossoms and had scores of these insects come tumbling out. Professor Sargent says that planting this Magnolia in the garden is a good way to trap the rose bugs to keep them away from the Roses.

Of course it is impossible to duplicate at the Arnold Arboretum anything like the wonderful Cherry blossom shows which have long been a feature of Japanese life. Nevertheless, the display along the drive leading from the Forest Hills entrance is worth while going a long distance to see. It is passing strange that more use is not made of these ornamental flowering trees in home gardens. The *Prunus subhirtella,* has perhaps the most beautiful flowers of all the Cherries. It blooms profusely every year, and holds its blossoms much longer than any other single-flowered Cherry. Unfortunately, it cannot be multiplied by seed, as the seed produces an entirely different plant. The only way to propagate *Prunus subhirtella* is by grafting or by cuttings.

The Sargent Cherry, or as it is now commonly called, *Prunus serrulata sachalinensis,* is one of the most important trees in northern Japan and Saghalin, where it is used for lumber. When it is in flower it is the handsomest of all the large size Cherries. This is one of the most important introductions made by the Arboretum, both as an ornamental tree and as a timber tree. The Cherry plantation in the Arboretum is being extended, and in years to come will doubtless make a show approximating to some extent that which attracts the Japanese by thousands to the Cherry orchards in the Spring. A large number of Cherry trees have also been supplied to Rochester, N. Y., where several acres in the public parks are being devoted to their culture.

Hardly second to the Cherries in beauty are the Crabapples, which are also grouped near the Forest Hills entrance, with a second collection on Peters Hill. These Crabapples make a wonderful burst of bloom in the Spring, and ought to be better known to garden makers everywhere.

Malus floribunda is a tree without a country. That it was sent to Europe from Japan more than sixty years ago is well known, but nobody knows with certainty from what country Japan adopted it. We can only assume that it came from China, like many of the other crabs. In any event, it is wonderfully handsome, never failing to cover itself with masses of beautiful flowers, deep rose in the bud, but turning to white after the petals open. This little tree is far better for home gardens than many of the shrubs commonly used. Professor Sargent calls it one of the handsomest and most desirable small trees which can be grown in the northern United States.

Malus Sargentii is another small crab, the diminutive size of which makes it a good subject for small gardens. It was discovered by Professor Sargent on the borders of a salt marsh in northern Japan. Although rarely growing more than a few feet high, its branches spread out over a space ten or twelve feet in diameter. One attractive feature about this crab is that its fruit remains on the branches until Spring.

Trees raised from seed gathered from plants in a large collection like the one in the Arboretum rarely resemble the parent. While this makes trouble for the botanist, it has a distinct advantage for

the gardener, often resulting in the development of beautiful new forms, which come spontaneously. Such a natural hybrid is *Malus Arnoldiana.* It appeared a few years ago among the seedlings of *floribunda,* and promises to be a welcome addition to our gardens. Many persons consider this to be the handsomest of all ornamental crabs. Its flowers and fruit are twice as large as those of *Malus floribunda.*

Some of the Pear trees are almost as attractive as the crabs. *Pyrus Calleryana* is not among the handsomest and the fruit is of no value. It is believed, though, that this tree offers special advantages to American pomologists, who are seeking a stock resistant to blight on which to graft garden Pears. Pear trees are natives of Europe, China, and the Himalayas. There are no native American Pears. Some of the Chinese species have been growing in the Arboretum since 1882, when Dr. Bretschneider sent seeds there from Peking.

It is when the Lilacs are in bloom that the greatest number of people visit the Arnold Arboretum, probably because of the fame which has been given the Lilac show by the newspapers. Lilacs are used as a border along one side of Bussey Road, not far from the Forest Hills entrance. Many people speak of this section of the road as Lilac Drive. In late May, when the Lilac show is at its height, thousands of people come to the Arboretum to see the magnificent burst of bloom. Altogether, though, there are almost two months in which the Lilacs are in flower in the collection, including nearly every species and variety of the common Lilac alone, with twenty species in addition and several hybrids.

In his various expeditions, Mr. Wilson has discovered a number of extra-fine Lilacs, one of the best being *Syringa Julianae,* a hardy and very shapely shrub, with dark green foliage, and compact clusters of fragrant, pale rose-colored flowers. It is particularly valuable as it blooms later than most true Lilacs. While sweet, it lacks the strong fragrance of *pubescens,* which is the most fragrant of all the Lilacs. In respect to perfume, however, even *pubescens* will soon have a rival, for during the last trip of Mr. Wilson through the far East, he discovered a Lilac in Korea which he says is more fragrant than any which has yet been grown on the American continent. In about five years this statement can be

tested by Boston people, for the seeds brought back by Mr. Wilson should have produced flowering plants by that time.

Syringa villosa is a very handsome Lilac with one point distinctly in its favor. It blooms late, thus prolonging the flowering season of the Lilacs. On the other hand, it has an odor which is distinctly disagreeable. *Villosa* makes a fine, round-topped bush, and if you refrain from sniffing the blossoms, you will find it a splendid acquisition. Look it up next Spring when the Lilacs are in bloom.

A remarkable Lilac known as *Syringa reflexa* grows on the mountains of western Hupeh, in central China, where it was discovered by Mr. Wilson several years ago. It is especially interesting because it is the only Lilac with pendent flower clusters.

There are scores of Lilac varieties in commerce, but trials made at the Arboretum show that the list of kinds suited to the average garden can easily be culled to a dozen. It will be worth the while of any garden maker fond of Lilacs to visit the Arboretum next Spring, when the flowers are in bloom, and note those which please him most. Then, by consulting an Arboretum Bulletin, he can find whether they are suitable for culture in home gardens.

On the south side of Lilac Drive the Viburnums are grouped, and they, too, make a remarkable display over a long season. The Viburnums are highly valuable, because they give us flowers very early in the season, as well as handsome fruit in the Fall. Four American species have been used freely in the roadside plantations of the Arboretum. One of the most satisfactory is *Viburnum cassinoides*, a native New England shrub with a broad, round top, and thick lustrous leaves. The flowers are cream white and the fruit, while pink for a short time, gradually changes color to dark blue. Sometimes green, pink, and blue berries are to be found on the same cluster at the same time.

Another native Viburnum is *pubescens*, which deserves much wider recognition on the part of landscape gardeners than it has yet received. The success achieved by the use of native shrubs of this character in the Arboretum planting indicates the possibilities which our own plants possess as subjects for landscape work on a large scale. *Viburnum pubescens*, especially, grows in limestone soil, yet lime is not necessary for it, and it can be grown over most of the country. This species has small pointed leaves, and

compact clusters of white flowers, followed by shining black fruits. No other Viburnum flowers more profusely. In the collection of Viburnums are many representatives of western Asia. Unfortunately, however, the group does not include the beautiful evergreen species of southern Japan and China, which are not hardy in New England.

The most interesting specimens in the collection are those which belong to the Opulus group, *Viburnum Sargentii* being one of the best representatives. It is hardy, shapely, and the flowers are pure white. When this Viburnum is blooming it is the most beautiful of all its class. Seek it out next June at the side of Bussey Road.

The Azaleas occupy a place of their own on the side of both the Bussey and Hemlock Hills. The most popular collection is on the former elevation, where a large number of the plants are grouped along Azalea path. Few flowers in the Arboretum attract more attention or give greater pleasure. Most gorgeous of all the Azaleas is *Kaempferi*, which was introduced by the Arboretum into the gardens of the United States and Europe in 1893. It was first raised from seed collected by Professor Sargent in Japan. It is perfectly hardy, but the flowers are so delicate, when exposed to the sun, that they soon fade. The greatest beauty of *Azalea Kaempferi* is obtained when the plants are grown in deep or partial shade.

In introducing *Azalea Kaempferi* to New England the Arnold Arboretum has given our gardens a prize not readily excelled. It is a magnificent plant, and in time will be grown in great numbers, as landscape gardeners come to know it better. Moreover, it is just as adaptable to small gardens as to large estates. No one living in Boston should fail to see the Azalea show at the Arboretum.

Another Azalea which makes a wonderful burst of bloom is *poukhanense* which was introduced into the Arboretum by Mr. Jack on the occasion of his trip to Korea some years ago. It was named for Poukhan, a Korean mountain, where it has been found by a French missionary. A beautiful round-topped, compact shrub, with large rosy-pink and fragrant flowers, it seems to be perfectly hardy anywhere in the Arboretum, where it has been flowering for several years. It should prove a good plant for New England gardens, and people who are interested in Rhododendrons

of all kinds would do well to seek it out when it flowers next May. It is to be found on the upper side of Azalea Path.

One of the big floral displays at the Arboretum is made when the Rhododendrons come into flower. The Rhododendron collection borders the road at the base of Hemlock Hill. Unfortunately, a great many people miss it because they go to the Forest Hills or Jamaica Plain entrances, which are a long way off. By leaving the elevated train at Forest Hills and walking up South Street to the South Street entrance, the Rhododendrons are reached in a very few minutes. The Arboretum collection is so extensive, and the plants arranged so skilfully that it offers an unparalleled opportunity to become familiar with the best varieties, as well as with the methods to follow in the culture of Rhododendrons in this climate. There are three native American species and one other, *Rhododendron Smirnowii,* from the Caucasus, which are perfectly hardy, and can be planted with confidence.

Rhododendron album grandiflorum is a white flowered form of a hybrid *catawbiense.* Many hybrids have been produced by crossing *Rhododendron catawbiense* with various Himalayan species, as well as with the native *Rhododendron maximum.* Unhappily, only comparatively few of these hybrids are hardy in this country, even in exceptional positions like that in the Arboretum, where the beds are protected by Hemlock Hill from the sun in March and April.

Of the three native Rhododendrons, *maximum* and *catawbiense* are well known. The third, *carolinianum,* is much less generally cultivated, but it is to be found growing to perfection in the Arboretum. It, too, comes from the Carolina mountains, but has a dwarf habit. Its flowers are grown in profusion, and seldom show any trace of rust. There is every reason to believe that this introduction will fill a long felt want for a hardy dwarf Rhododendron whose flowers have no trace of magenta. It seldom grows more than eight feet high, and has dark green leaves, covered with rusty dots below. The flowers come in June, and are borne in great profusion, fairly smothering the plant in a rose-colored blanket. Incidentally it may be said that this Rhododendron was named by Mr. Rehder of the Arboretum staff.

England is fighting now with the Rose as her national flower. France has her Fleur-de-lis; but the United States has officially no

national flower. If such a flower should be chosen, probably the Mountain Laurel would be the most conspicuous candidate for the honor. The Mountain Laurel is not found in any other land, but it is very widespread in America. There is a big collection in the Arboretum, near the South Street entrance, at the base of Hemlock Hill. The flowering of the Laurels is the last of the great Arboretum flower shows of the year, and none of those which precede it are more beautiful, for the Mountain Laurel, or the Calico Bush as it is often called, is in the judgment of many flower-lovers the most beautiful of all North American shrubs or small trees.

This great Laurel show in the Arnold Arboretum did not happen all at once. Jackson Dawson, the wonderful gardener who helped during all his life to make the world more beautiful, selected many of these Laurel plants in the mountains of Connecticut, Massachusetts, and New York.

Not far from the Rhododendrons and Laurels is a collection of Yews, which excite much attention. The Japanese Yew, *Taxus cuspidata*, is considered by Professor Sargent to be the most generally valuable plant which the northern United States has obtained from Japan. Its native home is in the forest of northern Japan, where it becomes a tree forty or fifty feet high. It has not grown as tall as in its native country, but is perfectly hardy, and never suffers in the coldest winter. It is an excellent hedge plant, too, and can be used advantageously in the decoration of formal gardens.

Another very interesting Japanese tree is *Acanthopanax ricinifolium*. As it grows at the side of a little pond not far from the Forest Hills Entrance, it makes an unusually attractive appearance. This tree belongs to the Aralia family, and the large, drooping leaves resemble in shape those of the Castor Oil Bean. The small, white flowers, which are produced in broad, flat clusters, do not appear until the middle of August, and are followed by small, black, shining fruit. People who want to cultivate a perfectly hardy tree, unlike any tree which is a native of North America or Europe, will find this Acanthopanax highly satisfactory.

Among the dwarfer Japanese plants the Junipers are especially interesting. They are to be found on the north side of Bussey Hill. The *Juniperus chinensis*, var. *Sargentii*, is the handsomest of the

dwarf Junipers which can be grown successfully in this climate. This shrub was named for Professor Sargent because he was the first man to collect it, finding the seeds in southern Hokkaido, in 1892. The plants raised from the seed which he brought home are probably the only ones in cultivation. It can be seen to advantage on the Hemlock Hill road, opposite the Laurels, where there are several large plants.

Several other Junipers are to be found in the Arboretum collection, and are of particular interest to landscape gardeners. Some of the more prostrate forms are highly valuable for covering banks and the margin of ponds. *Juniperus horizontalis* is an especially good garden plant, and *Juniperus procumbens*, a Japanese species, is being planted largely in California. It is perfectly hardy in the Arboretum, and may be grown as well here as in the west.

Eucommia ulmoides is the so-called hardy Rubber-tree and one of the most interesting of Chinese plants. The leaves contain a small amount of rubber, as can be seen by pulling a leaf apart. It has no economic value but Eucommia is a good ornamental tree for the northern states on account of its thick, dark green, shining leaves and good habit. It is well established in the Arboretum where it has flowered.

The plantation of young Cedars of Lebanon is the result of an experiment in naturalization undertaken by the Arboretum. The Cedar of Lebanon grows on the Lebanon Range in Syria, and also on the Anti-Taurus Mountains in Asia Minor, a more northern and much colder region. In its southern form it is not hardy in Massachusetts and an effort to secure a hardy race of this important and interesting tree led the Arboretum several years ago to have seeds gathered at the northern limits of its range in Asia Minor. Plants raised from these seeds have been growing in the Arboretum for fifteen years in exposed, windswept positions, and have not been injured by the exceptional cold of several winters. The seedlings of no other conifer raised in the Arboretum have grown so rapidly, the largest of these plants having attained the height of twenty-two feet in twelve years from the time the seed was planted.

As had been said, the Arnold Arboretum is really a museum of trees, the greatest institution of the sort in the world. It is fitting,

therefore, that the native trees should have a very large representation. They have been grouped for easy study, and can be found with but little difficulty. Among the handsomest are the Oaks, and they are particularly beautiful in the Arboretum, because allowed to grow in a natural way. The Red Oak rears its huge trunk from a bed of wild Asters, a natural forest floor in the Arboretum grounds.

Among the most interesting of the deciduous trees are the Maples, a large collection of which may be found near the shrub garden. It includes both native and foreign species. The fastigiate Sugar Maple, *Acer saccharum*, var. *columnare*, is of particular interest to landscape gardeners, as it can be used as a substitute for the more short lived Lombardy Poplar. It is quite as pyramidal in form, and handsomer in foliage, but of course does not grow nearly so rapidly. This column-like Maple was first discovered in a Newton cemetery, and whatever trees of the type exist at the present time have come from this parent.

Many visitors to the Arboretum find the pinetum the most interesting feature of all. The pinetum is close to the Walter Street gate. Among the notable trees to be found there is the Carolina Hemlock, a native of the Blue Ridge, where it forms extensive forests on high mountain slopes. It is one of the most beautiful of the coniferous trees that are hardy and that can be successfully grown in the northern states. The Carolina Hemlock was first raised in the Arboretum more than thirty years ago. Judging from the behavior of the tree, it may be placed among the six most desirable conifers that can be planted in southern New England, the others being the White Pine, the Red Pine, the Northern Hemlock, the White Fir of Colorado, and the Japanese *Abies brachyphylla*.

The last named fir, which is also called *Abies homolepis*, is one of the handsomest and most satisfactory of all the conifers which Japan has sent to this country. It has dark green leaves, which are silvery-white on the lower surface, and its cones are rather unusual in color, being a violet purple. There is a tree in the Hunnewell pinetum fifty-five feet high, with branches which sweep the ground, and illustrate the beauty of the mature specimen. The Arboretum trees are smaller, but already are producing their handsome cones.

Many coniferous trees have produced abnormal forms, that is, individuals with abnormally erect or pendent branches, or with short branches which grow so slowly that they form little round-topped bushes often not more than two feet high. All such plants are interesting, some of them are beautiful. They have always been favorites with nurserymen, and an unusually large collection is cultivated in the Arboretum. A form of the White Pine, with erect growing branches is called *Pinus strobus fastigiata.* The tree from which the plants in the Arboretum were propagated was found in the woods of Massachusetts many years ago by Jackson Dawson. This pine is considered the handsomest of the conifers with erect-growing branches which can be grown in the northern states.

In the Arboretum are weeping forms of the common Red Cedar, *Juniperus virginiana,* with pendulous branches. Of the numerous seedling forms of the Red Cedar this is one of the most distinct. It is also one of the handsomest of the hardy conifers with pendulous branches.

The so-called Weeping Hemlock, *Tsuga canadensis pendula,* is often called the Sargent Hemlock in honor of the late Henry Winthrop Sargent of Fishkill Landing (now Beacon) New York, who in his time had one of the largest collections of conifers in America.

The beauty of the Arboretum does not pass with the passing of Summer. On the contrary, the Fall display of fruits, berries, and brilliant foliage is almost as fine as that made by the flowers in the Spring. *Evonymus Bungeanus* is a native of northern China, and is a small tree with slightly pendulous branches. When Fall comes, its narrow leaves turn a clear bright yellow. The greatest beauty of this plant, though, lies in its fruit, which is pink and very abundant. The fruit is held for several weeks after the leaves fall, and makes a glorious display along the Meadow Road, worth twenty minutes of any man's time to visit. Nowhere else in all the world can so many different plants with brilliant Autumn foliage and handsome Fall fruits be found in one collection. Likewise there is no other garden in all the world where these plants can be so easily and conveniently studied.

Every garden maker by rights should plant with the idea of keeping his garden gay with color practically the year round. As

Bacon puts it: "I do hold it in the Royall Ordering of Gardens that there ought to be gardens for all the months of the year; in which severally things of beauty may be there in season." One of the good plants to use is *Ligustrum vulgare foliosum.* This is a form of the common European Privet, but differs from it in having narrow leaves and larger fruit. It holds its leaves without a change of color until the beginning of Winter, which makes it a good subject for garden decoration. Its black berries are borne in great profusion and in large clusters which add to its ornamental value.

Even though the leaves may fall and the berries be eaten by the birds, it is still possible to have plenty of color in the garden by planting shrubs which possess red and yellow stems, particularly the Dogwoods of different kinds. In a corner of the Meadow Road in the Arboretum a handsome collection of American Cornels may be found. Here we see *Cornus stolonifera* with red stems, and its variety *flaviramea* with yellows tems. These plants, with *Kerria japonica* to provide rich green stems, are splendid for any garden.

Even when the ground is blanketed with snow there is much of interest and beauty within the Arboretum gates. It is then that the Conifers, always delightful, show up to the best advantage. Scores of trees and shrubs carry their gaily colored fruit well into Winter. Some of the Hawthorns, of which there are several groups, keep their berries until Spring, and so do the Barberries. As a matter of fact it has been found from actual observation in the Arboretum that it is possible in this climate to have flowers every month in the year except possibly December. The foreign Witch Hazels begin to flower in late Winter, and last through until March, when some of the Willows burst into bloom.

Perhaps all this will give you at least a meager conception of the great work which the Arboretum is doing, the great task to which it has set its hand, and what it offers to the public as well as to specialists and nurserymen.

The Arnold Arboretum is a great living museum of trees and shrubs. It is more than that. It is a wonderful example of landscape gardening, one of the best in the world. Its influence upon American horticulture is incalculable, and this influence must necessarily go on growing, as long, may we hope, as the Arboretum lasts, that is to say, for a thousand years and then another thousand years, and so on forever.

NEW HORTICULTURAL CROPS FOR OUR SCANT FOOD SUPPLY.[1]

By Prof. U. P. Hedrick, Geneva, N. Y.

Delivered before the Society, February 2, 1918.

Economists prophesy a deficiency in the world's food supply. The cost of living everywhere portends accuracy in their divination. The fast and furious struggle between nations and individuals for land upon which to grow food augurs lean years to come. Census enumerations of population presage sooner or later a dearth of ammunition among the multiplying peoples of the earth to carry on the battle of life. Of all this you need to be reminded rather than informed.

So many men have stated and attempted to solve the problem of the future food supply that it would seem that the subject has been wholly talked out from the facts at hand. Indeed, there has been so much said and written about hard times at hand and famine ahead that I doubt if you are pleased to have your premonitions reawakened by further forebodings.

Agricultural economists discuss three rather general means of securing a food supply for those who live later when the earth teems with human beings. These are: conservation of resources; greater acreages under cultivation; and increased yields from improved plants and through better tillage. It is difficult to anticipate the problems that will confront us when people swarm on the land, as now in India or China, but I venture the prediction that if in that day "the evil arrows of famine" are sent upon us, a fourth means of supplying food will be found quite as important as the three named.

We shall find, long before famine overtakes us, that the natural

[1] This address was originally a presidential address before the Society for Horticultural Science and was printed in the report of the Society for 1913. It was given before the war and its revision and repetition seems to the writer justified by the world-wide shortage of food brought about by the war.

capacity of soils and climates to produce a diversity of crops is one of the greatest resources for an increased food supply. As yet, multiplicity of crops as a means of augmenting the supply of food has received little attention and I want to bring you to a better realization of its possibilities in the half hour at my disposal, attempting to show, in particular, how greatly the necessities and luxuries of life can be increased by the domestication of wild esculents; by better distribution of little-known food plants; and by the amelioration of crops we now grow through breeding them with wild or little-known relatives.

Few, even among those who have given special attention to agricultural crops, have a proper conception of the number that might be grown. De Candolle, one of the few men of science who have made a systematic study of domesticated plants, and whose "Origin of Cultivated Plants" has long been sanctioned by science as authoritative, is much to blame for the current misconception as to the number of plants under cultivation. By conveying the idea that his book covers the whole field, De Candolle prepared the ground for a fine crop of misunderstandings. Humboldt stated in 1807 that, "The origin, the first home of the plants most useful to man, and which have accompanied him from the remotest epochs, is a secret as impenetrable as the dwelling of all our domesticated animals."

De Candolle set out to disprove Humboldt. He assorted cultivated plants in 247 species and ascertained very accurately the histories of 244 out of the total number. De Candolle's thoroughness, patience, judgment, affluence of knowledge, clear logic and felicity of expression, make his book so trustworthy and valuable in most particulars, that we have accepted it as the final word in all particulars, overlooking his faulty enumeration and forgetting that most of his material was gathered more than a half century ago.

My first task is to establish the fact that the number of plants now cultivated for food the world over is not appreciated in either science or practice. Neither are botanists nor agriculturists seemingly well aware of the number of edible plants now domesticated which are in times of stress used in various parts of the world for food, many of which can well be grown for food. Your attention must be called to the number of these.

Inspiration for this discussion of the undeveloped food resources of the plant-kingdom came to the speaker from the use of notes left at the New York Agricultural Experiment Station by the first director of the station, the late Dr. E. Lewis Sturtevant, during his active life a member of this Society, who gave much time to the study of economic botany. His pen contributions on cultivated plants in agricultural and botanical magazines cover thirty years and number many titles. In addition, the unpublished material just mentioned, under the heading "Edible Plants of the World" takes up over 1,600 typewritten pages. During his life, Dr. Sturtevant was in the full tide of American science, but I am sure could he have lived to publish the great treatise which he had planned on edible plants, and upon which he worked for twenty years, we should give him much higher rank with giants of science, and that his book would now be the *magnum opus* of economic botany.

De Candolle, as we have seen, includes but 247 cultivated species in his work. This is approximately the number generally thought to minister to the alimentary wants of man. Sturtevant, in his notes on edible plants, enumerates 1,113 domesticated species now cultivated, and a total of 4,447 species, some part or parts of which are edible. Following De Candolle, Sturtevant made use of botany, archeology, paleontology, history and philology in obtaining his data. He searched the literature of the world from the earliest records in Egyptian, Chinese and Phoenician until the time of his death to make a complete record of the edible plants of the world. Sturtevant's were the species, too, of a generation ago, many of which have since been divided twice, thrice, or oftener by later botanists. It is said that no food plant of established field culture has ever gone out of cultivation, an approximate truth, at least, from which we may presume that the number of cultivated plants is not smaller than the numbers given from our author's notes.

In leaving this phase of my subject, I can not but say, despite the fulness of Sturtevant's notes, the feeling comes in reading them, as it does in reading De Candolle, Darwin or whoever has written on the domestication of plants, that what has so far been found out is so little in comparison to what we ought to know regarding the modification of cultivated plants by man, that our present knowledge but makes more apparent the dire poverty of our information.

Passing now to a more direct discussion of the subject in hand, I have to say that I have chosen to discuss three general means of developing the latent possibilities in the plant-kingdom for agriculture. It may help to hold your attention if I discuss these in order of their importance — the most important last. They are: First, the domestication of the native plants of any region. Second, better distribution of plants now cultivated. Third, the utilization of hybridization to bring into being new types of plants better suited to cultivation and to the uses of man.

In the matter of domesticating plants let us glance hastily at what has and what can be done in our own country. In De Candolle's treatise we make but a poor showing, indeed. Out of his 247 cultivated species but 45 are accredited to the New World, and but three of these — the pumpkin, Jerusalem artichoke and persimmon — come from North America. To these three, Sturtevant adds about thirty. The poor showing made by our continent in furnishing food plants, it must be made plain, is not due to original inferiority. The number would be vastly greater, as Asa Gray long ago pointed out, had civilization begun in this rather than in the Old World. It is probable, indeed, that the numbers would be approximately equal if civilization had begun as early in the Western as in the Eastern Hemisphere.

What are some of these plants that Gray and other botanists have so often told us might have been and may yet profitably be domesticated? The list is far too long to catalogue, but you will permit me time for a few examples, choosing those that are still worth domesticating for some special purpose or environment. Fruits give us most examples.

Wild fruits abound in North America. The continent is a natural orchard. More than 200 species of tree, bush, vine and small fruits were commonly used by the aborigines for food, not counting nuts, those occasionally used, and numerous rarities. In its plums, grapes, raspberries, blackberries, dewberries, cranberries and gooseberries North America has already given the world a great variety of new fruits. There are now under cultivation 11 American species of plums, of which there are 433 pure-bred and 155 hybrid varieties; 15 species of American grapes with 404 pure and 790 hybrid varieties; 4 species of raspberries with 280

varieties; 6 species of blackberries with 86 varieties; 5 species of dewberries with 23 varieties; 2 species of cranberries with 60 varieties and 2 gooseberries with 35 varieties. Here are 45 species of American fruits with 2,226 varieties, domesticated within approximately a half century. De Candolle named none of them. The final note of exultation at this really magnificent achievement of American horticulture would typically be uttered in a boast as to the number of millions of dollars these fruits bring fruit-growers each year, but science is not sordid and has not made the calculation.

What more can be done? The possibilities of the fruits named have by no means been exhausted. The fruit of the wild plum, *Prunus maritima*, an inhabitant of sea-beaches and dunes from Maine to the Carolinas, is a common article of trade in the region in which it grows, but notwithstanding the fact that it readily breaks into innumerable forms and is a most promising subject under hybridization, practically nothing has yet been done toward domesticating it. Few plants grow under such varied conditions as our wild grapes. Not all have been brought under subjugation, though nearly all have horticultural possibilities. It is certain that some grape can be grown in every agricultural region of the United States. The blueberry and huckleberry, finest of fruits, and now the most valuable American wild fruits, the crops bringing several millions of dollars annually, are not yet domesticated. Coville has demonstrated that the blueberry can be cultivated. Some time we should have numerous varieties of the several blueberries and huckleberries to enrich pine plains, mountain tracts, swamps and waste lands that otherwise are all but worthless. A score or more native species of gooseberries and currants can be domesticated and should some time extend the culture of these fruits from the Gulf of Mexico to the Arctic Circle. There are many forms of juneberries widely distributed in the United States and Canada, from which several varieties are now cultivated. The elderberry is represented by a dozen or more cultivated varieties, one of which, brought to my attention the past season, produced a half hundred enormous clusters, a single cluster being made up of 2,208 berries, each a third of an inch in diameter.

These are but a few of the fruits — others which can only be

named are: the anonas and their kin from Florida; the native crabapples and thorn-apples; the wine-berry, the buffalo-berry and several wild cherries; the cloud-berry prized in Labrador; the crow-berry of cold and Arctic America; the high-bush cranberry; native mulberries; opuntias and other cacti for the deserts; the paw-paw, the persimmon, and the well-known and much-used salal and salmon berries of the west and north.

The pecan, the chestnut and the hickory-nut are the only native nuts domesticated, but some time forest and waste places can be planted not only to the nuts named, but to improved varieties of acorns, beechnuts, butternuts, filberts, hazels, chinquapins and nutpines, to utilize waste lands, to diversify diet and to furnish articles of food that can be shipped long distances and be kept from year to year. The fad of today which substitutes nuts for meat may become a necessity tomorrow. Meanwhile it is interesting to note that the pecan has become within a few decades so important a crop that optimistic growers predict in another half century that pecan groves will be second only to the cottonfields in the south. A bulletin from the United States Department of Agriculture describes 67 varieties, of which more than a million and a half trees have been planted.

It is doubtful whether we are to change general agriculture much by the domestication at this late date of new native grains, though many may well be introduced from other regions and wonderful improvement through plant-breeding is, as all know, now taking place. Raw material exists in America for domestication, but it is not probable that we shall ever use it extensively.

There are, however, a number of native vegetables worth cultivating. The native beans and teparies in the semi-arid and subtropical southwest to which Freeman, of the Arizona station, has called attention, grown perhaps for thousands of years by the aborigines, seem likely to prove timely crops for the dry-farmers of the southwest. Professor Freeman has isolated 70 distinct types of these beans and teparies, suggesting that many horticultural sorts may be developed from his foundation stock. The ground-nut, *Apios tuberosa*, furnished food for the French at Port Royal in 1613 and the Pilgrims at Plymouth in 1620, and as a crop for forests might again be used. There are a score or more species

of *Physalis*, or ground cherries, native to North America, several of which are promising vegetables and have been more or less used by pioneers. *Solanum nigrum*, the nightshade, a cosmopolite of America and Europe, recently much advertised under several misleading names, and its congener, *Solanum triflorum*, both really wild tomatoes, are worthy of cultivation and in fact are readily yielding to improvement. *Amaranthus retroflexus*, one of the common pigweeds of gardens, according to Watson, is cultivated for its seeds by the Arizona Indians. In China and Japan the corms or tubers of a species of *Sagittaria* are commonly sold for food. There are several American species, one of which at least was used wherever found by the Indians, and under the name arrowhead, swan potato and swamp potato has given welcome sustenance to pioneers. Our native lotus, a species of *Nelumbo*, was much prized by the aborigines, seeds, roots and stalks being eaten. *Sagittaria* and *Nelumbo* furnish starting points for valuable food plants for countless numbers of acres of water-covered marshes when the need to utilize these now waste places becomes pressing.

The temptation is strong to continue this discussion of the domestication of native plants, but time demands that I pass to a consideration of the second potential of an increased diet, that of better distribution of the world's food-producing plants.

Beginning with the discovery of the New World, botanical and agricultural explorations have been carried on with zeal, and food plants have been interchanged freely between newly discovered lands and older civilizations. Yet in these centuries the food-plant floras of races have been changed but little. Quite too often a crop is found to be the monopoly of a race or nation irrespective of soil and climate, factors which ought to import a cultivated flora. It would seem that agriculturists would quickly adopt food plants grown elsewhere of which the advantage is evident, and be thereby diverted from the cultivation of poorer crops in their own country. Yet the introduction of foreign plants is usually arrested, if not actually opposed by the timidity of agriculture, and it has been most difficult to introduce new crops into old regions. This conservation on the part of those who grow the food plants of the country is due to a universal dislike in the animal kingdom, most strongly developed in the human family, to eating unfamiliar foods.

But travel is making all people less and less fastidious as to foods, as the numerous new foreign dishes in daily use in our own homes give evidence. Only savages and those who must struggle for sufficient food to sustain life line on one or a few foods.

Let us hastily run over a few foreign plants that may well receive more attention in America, naming fruits first as of most interest to this audience. Japanese plums and persimmons came to America in the medieval days of horticultural progress, and interest in them seems to have ceased. We need new importations of the many types not yet in the country. The fig is an ancient immigrant, but many desirable relatives were left behind. Date culture is now a most promising infant industry in the southwest. The Chinese jujube promises to be one of the most valuable of the many plants recently introduced into this country. The jujube is a hardy tree which has been cultivated in China for more than 4,000 years, being one of the five principal fruits of the new republic. There are hundreds of varieties differing in flavor and sizes, some growing less than an inch in length and others equaling the size of a hen's egg. One variety is seedless. Some kinds are eaten fresh, some are stewed.

Among the newest of the new on probation, but all clamoring for recognition, are the avocada from tropical America; the feijoa from Brazil; a dozen or more annonaceous fruits from the tropics, of which the cherimoya seems now to be most prominent; an edible Osage orange from Central China; the roselle, an annual from the Old World tropics, valuable for its fruit, stalks and seed. Several species of *Berberis* supply a refreshing fruit in northern Asia and might add variety to the rather spare fruit diet of the colder parts of this continent. Beside these are innumerable new citrus fruits, the number of species and varieties of which seem to be legion — the speaker is neither able to enumerate them not to tell where they begin or where they leave off. Swingle's splendid work with this genus is one of the most notable contributions to horticulture in recent years.

The mango has long been grown in Florida, but interest in mangos has recently been renewed through the introduction of choice Indian varieties. Poponoe describes 312 varieties of mangos grown in various parts of the world, of which as yet I judge there

are but few in America, though they are not difficult to grow in Florida, California or in our insular possessions. A quotation from Fairchild suggests the possible future of the mango in America. He says:

"The mango is one of the really great fruits of the world.... There are probably more varieties of mangos than there are of peaches. I have heard of one collection of five hundred different sorts in India. There are exquisitely flavored varieties no larger than a plum, and there are delicious sorts, the fruits of which are six pounds in weight. These fine varieties, practically as free from fiber as a freestone peach, can be eaten with a spoon as easily as a canteloupe. Trainloads of these are shipped from the mango-growing centers of India and distributed in the densely peopled cities of that great semi-tropical empire."

No one can read Bayard Taylor's fervent praise of the durian and the mangosteen and not desire to grow these fruits in America.

He says of the durian: — "Of all fruits, at first the most intolerable; but said, by those who have smothered their prejudices, to be of all fruits, at last, the most indispensable. When it is brought to you at first, you clamor till it is removed; if there are durians in the next room to you, you can not sleep. Chloride of lime and disinfectants seem to be its necessary remedy. To eat it seems to be a sacrifice of self-respect; but, endure it for a while, with closed nostrils, taste it once or twice, and you will cry for durians thenceforth, even — I blush to write it — even before the glorious mangosteen."

Listen to his laudation of the "glorious mangosteen."

"Beautiful to sight, smell and taste, it hangs among its glossy leaves the prince of fruits. Cut through the shaded green and purple of the rind, and lift the upper half as if it were the cover of a dish, and the pulp of half-transparent, creamy whiteness stands in segments like an orange, but rimmed with darkest crimson where the rind was cut. It looks too beautiful to eat; but how the rarest, sweetest essence of the tropics seems to dwell in it as it melts to your delightful taste."

One need not titillate the palate to enjoy such fruit. Can they be so delectable? Surely we can find a place for them somewhere in America.

Let us turn to a few examples of promising vegetable and farm crops of foreign countries not yet cultivated in the United States. Only those which give most emphasis to the present paper can be mentioned.

All know that rice furnishes the chief food of China, but few are aware that sorghum is as important a crop in Asia as rice and that it is the chief food of a large part of Africa. In China not only are the stalks of sorghum used, but bread is made from the seeds. In parts of India, sorghum is the staff of life. The Zulu Kaffirs live on the stalks, which are chewed and sucked, and Livingstone says, "the people grow fat thereon." The several species of yams constitute one of the cheapest and most widely distributed food plants in the world, yet the yam is little grown in America. Several genera of Aroideae, as *Caladium*, *Alocasia*, *Colocasia*, and *Arum*, each with innumerable varieties, furnish taro, arrowroot, ape and other more or less familiar food to the South Sea islanders. In a bulletin from the United States Department of Agriculture, under the title, "Promising Root Crops for the South," these Aroids, called under their native names of yautias, taros, and dasheens are recommended as most valuable wet-land root crops for the South Atlantic and Gulf States. Of the place of the cocoanut in the world's economy I need not speak. Varieties of Maranta were grown in Mississippi and Georgia in 1849, but disappeared. From one of the several species of this genus comes the arrowroot of commerce. Arrowroot is a favorite food of the Fijis and their neighbors, as well as of the inhabitants of Cape Colony, Natal, and Queensland. May not arrowroot some time be produced profitably in America? The banana has been on our tables less than a generation, yet it is now one of the commonest foods. There are several species and many varieties yet to be introduced into the tropics of America. The leaves and buds of several agaves furnish an abundant and a very palatable food to our southern neighbors. From plants of the large genus *Manihot* of equatorial regions, tapioca is made under conditions which could be greatly improved. As cassava, one of these manihots is already important in the United States and may some time compete with corn and wheat in the food supply of the country.

To quench the thirst of the teeming millions in time to come

there may be a multiplicity of beverages as well as of foods to mitigate hunger. In Arabia several millions of people drink khat, while in southern South America as many more millions allay their thirst with maté. Maté, according to Fairchild, can be produced at but a fraction of the cost of tea and supplies the same alkaloid in a more easily soluble form. Both contain thein, the active principle in "the cups that cheer but not inebriate." Sturtevant names twelve plants the leaves of which are used in different parts of the world to adulterate or in place of tea. We have but just acquired the use of cocoa and chocolate from the natives of our American tropics and of cocacola from the negroes of Africa, and it is not unlikely that we shall find other similar stimulants. For drinkers of more ardent beverages, if King Alcohol continues to reign, there is an abundance, the diversity and cheapness of which probably will ever as now be regulated by taste and taxes.

Time prevents my naming other valuable foreign plants that deserve to be tried in our agriculture. It is fortunate for American farming that men from the United States Department of Agriculture are now searching everywhere for new material. Saul went in search of asses and came back with a crown. So these men sent to foreign countries for material, possibly commonplace enough, are bringing back treasures the value of which in many cases will be incalculable. Introduction of seeds and plants for the nation is work to which the institutions represented here should lend aid in every way possible.

The last of the three means of developing plants for food, and as I believe the most important, is by using either foreign species or wild native species to hybridize with established crop-plants. It needs but a brief statement of what has been accomplished in increasing hardiness, productiveness, disease resistance, adaptability to soil, and other essentials of standard crop-plants, to show that through hybridization of related species we have probably the best means of augmenting our diet. Let us glance at a few recent accomplishments of hybridization, noting chiefly results with horticultural plants.

Downing in 1872 described 286 varieties of 4 species of plums. In the 40 years that have elapsed the number has increased to 1,937 varieties representing 16 species. Now the significant thing

is that whereas Downing's plums were pure-bred species, 155 of the present cultivated plum flora are hybrids between species. Downing could recommend plums for only a few favored regions. Some kind of plum can be grown now in every agricultural region in North America. Even more remarkable is the part hybrids have played in the evolution of American grapes. At the beginning of the nineteenth century, the grape could not be called a cultivated crop on this continent. Now there are 16 species and 1,194 varieties, the most significant fact being that 790 or three-fourths of the total number are hybrids. The grape through hybridization has become one of the commonest cultivated plants. The genus *Rubus* promises to attract and distract horticulturists next. As nearly as I can make out there are about 60 species of *Rubus* in North America. In the two completed parts of Focke's "*Species Ruborum*," 273 species are described. Raspberries, blackberries, dewberries and their like hybridize freely and we already have in the loganberry, the purple-cane raspberry, the wineberry and in the blackberry-dewberry crosses valuable fruits. If any considerable number of Focke's several hundred species can be similarly mixed and amalgamated, the genus *Rubus* will be one of the most valuable groups of fruits.

The speaker a few years ago made a study of cultivated cherries. When the work began a few years ago about a score of species were in sight. Koehne, a recent botanical monographer of the subgenus *Cerasus*, to which our edible cherries belong, describes 119 species, many of them but recently collected by Wilson in Asia. There are enough hybrids between species to indicate that cultivated cherries will some time be diversified as plums and with quite as much advantage to the fruit.

Webber's and Swingle's work in breeding hardy citrus fruits; blight-resisting pears as a result of crossing *Pyrus communis* and *Pyrus sinensis*; Burbank's spectacular hybrid creations; the diversity of types of tomatoes, potatoes, egg-plant, peppers, beans, cucurbits and other vegetables, not to mention roses, chrysanthemums, orchids and innumerable flowers, suggest the possibilities of hybridization. We have not done what lies within our reach in crossing cereals — corn, wheat, oats, rye, buckwheat, the last especially, remain yet to be touched by the magic wand of hybridi-

zation. Hybrid walnuts, chestnuts, hickories, and oaks, promise a wonderful improvement in nuts.

Truth is we do not know how much nor what material we have to work with in many of the groups of plants I have named, lending color to the saying that the plants with which man has most to do and which render him greatest service are those which botanists know least. This brings me to the last division of my subject.

Nothing is more certain than that we are at the beginning of a most fertile period in the introduction of new and the improvement of old food-plants. Yet agricultural institutions are most illy prepared to take part in the movement. "Art is long and time is fleeting," can be said of no human effort more truly than of the improvement of plants, and haste should be made for better preparation. Looking over the material that is usable in agricultural institutions, it seems that we are sadly lacking in the wherewithal upon which to begin. It is indispensable for effective work that we have an abundance of material and that we know well the plants with which we are to work.

How may the material be had? We are fortunate in the United States in having the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture for the importation of foreign plants. This office has effective machinery for the work. It maintains agricultural explorers in foreign countries. It is in direct contact with the agricultural institutions of other countries as well as with plant-collectors, explorers, consuls, officers of other countries, and missionaries. Through these agents it can reach the uttermost parts of the world. Morevoer, it has trained men to identify, to inventory, to propagate and to distribute foreign plants. This office can better meet quarantine regulations than can private experimenters or state institutions. All interested in foreign plants ought to work in cooperation with the Office of Foreign Seed and Plant Introduction of the Department of Agriculture.

To be used advantageously material must be near at hand. This means that there must be botanic gardens. There should be in every distinct agricultural region of the country a garden where may be found the food plants of the world suitable for the region. It is strange that in the lavish expenditure of state and federal

money in the agricultural institutions of the land, that so little has been done to establish and maintain comprehensive plantations of economic plants. Now that the amelioration of plants is a part of the work of agricultural colleges and stations it would seem that the establishment of such gardens is imperative. True, there are botanic gardens, but the museum idea is dominant in most of them — they contain the curiosities of the vegetable kingdom, or they show the ornamental and beautiful, or they are used for purposes of instruction. We need agricultural gardens in which agricultural plants are dominant rather than recessive.

There is another difficulty quite as detrimental to progress as inability to obtain material. It is the lack of trustworthy information in regard to economic plants. Quite as necessary as agricultural gardens is an agricultural botany. In this botany must be set forth, besides descriptions of species, the habitat, the migrations, the geographical relations to other plants, the changes that have occurred, how the plant is affected by man-given environment, and all similar data. Physiological facts regarding germination, leafing, flowering and fruiting must be given. The production of such a book is a consummation devoutly to be wished.

Lastly, material and books do not create. The man has not been lost sight of, but I should have to set forth his temper and training too hurriedly even if I could properly conceive them. But from the beginning to the end of this new shaping of food crops, the individual man trained for the work will be dominant. The work to be done, however, is so vast that we can not make an appreciable showing unless the task be divided among a great number of workers. Those who will do most are such as can concentrate on particular problems the sifted experience and knowledge of the world. Many may sow, but only the strong can garner.

In conclusion, I must end as I began by calling attention to the great probability of a near-at-hand deficiency of food. I must again urge the importance of making use of every means of increasing the supply. I have tried to call attention to the desirability of growing a greater number of food-plants as one of the means. Not to attempt to develop and utilize to its highest efficiency the vast wealth of material in the plant-kingdom for the world's food is improvidence and is a reckless ignoring of splendid opportunities to increase the number of food-crops and thereby the world's food supply.

THE PEONY.

By Bertrand H. Farr, Wyomissing, Pa.

Delivered before the Society, with stereopticon illustrations, February 16, 1918.

I remember the first Peony I ever saw. It was the first year when father took us west, and I was six years old. It grew in my aunt's garden. It wasn't a real Peony, it was just a "Piney," one of those old-fashioned red ones that grew in all old ladies' gardens, but I thought it was very beautiful. I told her if she would give me a bloom, I would drive her cow home from the pasture that night. The arrangement was mutually satisfactory, and after further negotiations she agreed that if I would drive the cow home for one week, she would give me a "Piney toe," and so I came into possession of my first Peony.

More than 25 years elapsed before I owned another Peony, but when in 1897 I came to Wyomissing, where I could have a real garden, one of the first things I determined was to have a complete collection of Peonies, "a white one, a red one and a pink one." Then I discovered that Ellwanger & Barry had a great collection as many as twenty kinds. After I had gotten these, one of Lemoine's catalogues fell into my hands and, after some hesitation over the extravagance, I made the plunge. I sent to him my first foreign order in 1901. Only then did I realize what was before me, but it was too late. The Peony bug had gotten me, as it has gotten many others, and will get you too if it once gets fairly hold of you. Orders from Dessert and others soon followed. Then from Kelway in England.

There must have been a sort of Peony epidemic prevalent at that time, for I learned afterwards that a number of those who today are well known in the Peony world, were similarly affected at about the same time in the same manner, the two Petersons, Shaylor, McKissock, Ward, John Good, Betcher and others. In the Thur-

low ranks, where it had partly subsided (Mr. Thurlow having recently sold his collection), there was a fresh outbreak of the craze. I was not then in touch with these people, but I had heard of a Peony Society. I came home, packed my grip and started to Boston to see the Peony Show, and learn something about Peonies.

Ever since then Boston has seemed to me the "Hub" in Peony matters, as it used to be for me in things musical, for here in this hall I got my first real inspiration. I stopped off at Cottage Gardens to see Mr. Ward, President of the Peony Society. He was busy collecting flowers for the show, noting new things coming into bloom for the first time, identifying things untrue, etc., and trying his best to be polite to me, all at once. In the light of later experience, I can appreciate his position, but neither he nor I suspected then that I was to be his successor.

I have brought with me a photograph of that Peony Show in 1906, that I took myself. Over on one table is a display of Hollis' new seedlings. Several of them, Paradise, Goliath, Bunker Hill, and Welcome Guest received certificates of merit. He also showed a fine lot of Japanese types, then little thought of, but since these have become very popular. Among these especially were Glory, Bobby Bee, and Attraction. Mr. Shaylor carried off the honors, as he has done so many times since, with his splendid collection. Mr. McKissock was there with his fine collection of novelties from France. Of course the Thurlows were represented there, and in the center of the room stood a massive great vase of Richardson's Rubra Superba, which carried off the first prize. Here I first met the Rev. C. S. Harrison, "Evangelist of the Peony," for he, more than anyone else has preached the gospel of the Peony throughout the great northwest. Here I met our Mr. Fewkes, whom all of us of the Peony Society have come to hold in such sincere regard. I visited T. C. Thurlow, the first of the great Peony enthusiasts in New England, at his delightful and hospitable home. I visited James McKissock, and his beautiful collection at West Newton.

Up at Wellesley Hills I found Mr. Shaylor among his Peonies. In one corner, carefully screened under a tent from the hot sun, we came to the climax of our visit, when he said to us, "There, gentlemen, is the celebrated Lady Alexandra Duff." He was doomed to disappointment, for it turned out at the show to be

identical with Grandiflora Nivea Plena. Others had had similar disappointments, for Lady Duff turned out to be first James Kelway, then Mrs. Gwyn Lewis, and a host of other things, even to Festiva Maxima, till Mr. Shaylor in disgust, pronounced the Lady a myth, using a famous quotation, "There ain't no such thing." Mr. Kelway finally got so stirred up over the storm of criticism from his angry patrons in this country, that some years later he sent to several of us what he declared was a really truly Lady Duff, accompanied by photographs from his own garden, showing the original plant in flower. I met many others there, whom for lack of time I cannot mention, but I formed friendships with them that have endured to this day. Some of them have passed away, but the greatest thing I learned was that Peony people as a class are mighty fine people. They are true blue. For they grow Peonies, not as a commercial proposition, but because they really love the flower, and find in it a fascination that cannot be resisted.

The Peony is a true aristocrat of the hardy garden. I do not apply this as a mere phrase, for it is true in every sense, both as to its lineage and its associations. In China it is said that the Tree Peony has been their chief pride and glory for nearly 1500 years, a theme for their poets and painters, and prized by their emperors for the beauty and fragrance of its flowers; and for more than a thousand years a record of the characters, qualities, and parentage of the new varieties raised from seed has been kept. In their gardens the Tree Peony is known as the "King of Flowers," and the herbaceous Peony as the "King's Ministers." It is descended from Paeonia albiflora, a native of Siberia. Knowing this, I can well understand why it thrives so luxuriantly in the rich alluvial soil of our western states, and why it is the flower for the great Northwest, enduring, as it does, the most intense cold without injury. This Asiatic Peony must not be confused with the old-fashioned, early flowering red Peony of our grandmothers' gardens, which belongs to an entirely distinct species, officinalis, a native of Europe, the early history of which is intricately woven with a haze of superstition, allegory, and myth. Its magical charms were supposed to ward off witchcraft, and the name Peony is derived from a Dr. Peon, who used its roots as medicine.

The modern Chinensis Peony has only been known in Europe a

little more than half a century. It was under the care of M. Jacques, gardener to King Louis Philippe, that one of the first collections was formed, and some of the first of the fine varieties of today originated. M. Jacques' collection was inherited by his nephew, M. Victor Verdier, who raised a number of fine seedlings. The collection of the Comte de Cussy, an amateur collector, was inherited by M. Calot, of Douai, who continued to raise seedlings till 1872, when his collection passed into the hands of M. Crousse, of Nancy, who made careful selections from the Calot seedlings and sent them out annually until 1879. From 1882 until 1899, Crousse sent out seedlings of his own raising. The Calot-Crousse varieties are noted for their uniform high quality, raising the standard of excellence to a height that has never been surpassed, unless it be by the splendid varieties introduced in recent years by that greatest of all the world's hybridizers, Victor Lemoine, whose establishment at Nancy is at Crousse's old place. All the Lemoine varieties are exquisitely beautiful, but most of them so rare, they are but little known outside of the larger collections.

Another famous French collector of Peonies, contemporary with Calot and Crousse, was M. Mechin, also an enthusiastic amateur, whose grandson, M. A. Dessert, of Chenonceaux, succeeds him, and is considered today the greatest living authority on Peonies. Among his most recent introductions may be found some of the most beautiful additions to the many fine varieties for which we are indebted to the French specialists. Recently a number of fine new varieties, which are yet but little known in this country, have been originated in France by Riviere, Paillet, Brochet and others. To these must be added the beautiful varieties raised by James Kelway, of England, who began his work on the Peony in 1864, and twenty years later catalogued forty-one new varieties of his own raising.

Among those who have been most prominent in the introductions of new Peonies in America which equal those of the finest French introductions, was John Richardson, of Dorchester, Massachusetts. Robert T. Jackson in his paper published in the Transactions of the Massachusetts Horticultural Society for 1904, "John Richardson, His House and Garden" writes: "Mr. Richardson had a perfect passion for horticulture, and every plant in his garden that he loved

so well was a real personality to him. A walk with him about the garden meant a lingering at every step to consider the merits, the history, or some cultural point in regard to the plants that were as his children. When nearly ninety, he planted Peony seeds just the same as in his earlier years, and some of his posthumous seedlings are among his best." His varieties are all of unusual merit. Milton Hill and Paul Fisher are among the best; Walter Faxon stands alone, unapproached by any other Peony in its color, the nearest true deep pink; while Rubra Superba, crimson, and Grandiflora, soft shell-pink, still stand at the head, as the best and very latest of these colors to bloom. H. A. Terry, of Crescent, Iowa, early became interested in Peonies, and produced many varieties, the best probably being Grover Cleveland, Etta, Emma, Princess Ellen, Euphemia, and Stephanie. Writing in 1904 he says, "I am now in my eightieth year, and do not know how long I shall continue to grow Peonies, but I want to be surrounded by them as long as I live. They are like my children, very dear to me."

It was in Boston, in 1906, that I first met Mr. Hollis and saw his beautiful blooms on exhibition. I thought them fine then, and in my garden since they have not disappointed me. He was a genial, kindly gentleman, with means and leisure to devote his time to his favorites. I visited him in 1910 when his Peonies were in bloom. Although stricken then with a fatal illness, unable to walk alone, he sat in the little summer-house overlooking his Peonies, happy in the sight of them, still able to talk with enthusiasm about his treasures and call them by name. Among his many fine ones are Paradise, Welcome Guest, Maude L. Richardson, Standard Bearer, George Washington, Bunker Hill, and Tragedie. Mention must also be made of his Japanese types, of which he raised a number which are distinct and fine.

Mrs. Sarah A. Pleas, now living in Whittier, California at the advanced age of over 83 years, is as actively interested in Peonies as when at her home in Spiceland, Indiana, she raised and introduced Opal, Elwood Pleas, and her now famous Jubilee, which carried off highest honors at the National Peony Show in Philadelphia last year. A. M. Brand, of Faribault, Minnesota, for many years has been giving his attention to the raising of seedling Peonies. His varieties are now attracting a great deal of attention;

his Martha Bullock, best known, was one of the prominent features in the show last year. Among his many new ones I would mention Mary Brand, Richard Carvel, and Francis Willard. E. J. Shaylor of Wellesley Hills, is devoting his later years to raising new varieties, and has already given us Georgiana Shaylor, Mary Woodbury Shaylor, Wilton Lockwood, and a number of others which have received certificates of merit at your shows here. We must not forget to mention Cherry Hill by Thurlow of West Newbury, and Karl Rosenfield, by Rosenfield of Omaha, Nebraska, as being two American varieties of exceptional merit. Some of you may remember the splendid exhibit of some fifty new unnamed seedlings made here two years ago by Prof. A. P. Saunders of Clinton, New York. You will want to keep an eye on his work, for possibly one of these days the long sought yellow Peony may appear in his garden, for he is after it, apparently on the right track, and I shouldn't wonder if he succeeds.

It will be seen, therefore, that nearly all of our modern Peonies are of comparatively recent introduction, and I am greatly impressed by the fact that practically all of the fine Peonies we have today have come to us through that remarkable group in France, Calot, Crousse, Lemoine, and Dessert, most of them having a family relationship, and the few enthusiasts in America, just mentioned, who have taken up the growing of Peonies because they found it intensely fascinating; for the Peony does not attract the commercial grower. In its propagation there is no easy, royal road to quick results. It takes from four to six years before blooms may be had from seed, and if, perchance, one seedling in a thousand has sufficient merit and distinction to justify its introduction as a new variety, it takes many more years to raise by the slow process of division, sufficient stock to be able to offer it to the trade. That is why the new varieties are so expensive; unlike a new Rose or Carnation, which in a few months can be increased to an unlimited supply through cuttings. It takes years to acquire a few plants from a Peony, and even today, some of the old varieties are still scarce.

The professional grower cannot afford to wait so long for results. So most of the work with the Peony has been done by those whose love for the flowers themselves, and the fascination of watching

them grow, has been their chief incentive. Here is an example of your real Peony lover: Two or three years ago I visited your Mr. Fewkes whom all of us Peony people have come to regard in such high esteem. After we had enjoyed the Peonies in his garden we went inside, where in a vase he had three of the most wonderful blooms I have ever seen. They were Lemoine's La Lorraine and Dessert's Thérese and Rosa Bonheur. As we stood admiring them he remarked, "Do you know? it almost seems to me as if it is worth a year of a man's lifetime, just to be permitted to look upon a thing so beautiful!" Truly the Peony is an aristocrat.

Classification.

The Chinensis Peony (albiflora), in its original or wild state, was a single white flower, and the various stages of its transition from its original single type to the perfect double flower, forms the basis of the classification by the American Peony Society of the modern Peony in its various forms as follows: —

Single. Those with a single row of wide guard petals, and a center of yellow pollen-bearing stamens.

Semi-double. Those with several rows of wide petals, and a center of stamens and partially transformed petaloids.

Japanese. These have wide guards the same as the singles, but with the stamens and anthers greatly enlarged into narrow, thick petaloids of various colors, tipped with vestiges of yellow; the anthers are without pollen.

Anemone. A step farther in the process of doubling, with the stamens all transformed into short, narrow petals, forming a round cushion in the center of the flower.

Bomb. The next step, in which all the center petals are uniformly wide, approaching the guards, but distinctly differentiated from them, forming a globe-shaped center without collar or crown.

Crown. In this type wide petals are developed in the center of the flower, forming a high crown, with the narrow short petals forming a ring or collar around it. Often the crown and guards are of one color, and the collar another, or of a lighter shade.

Semi-Rose. Flowers in which the petals are all uniformly wide,

but are loosely built, with a few pollen-bearing stamens visible, or nearly concealed.

Rose. The process of doubling is completed, all stamens fully transformed into evenly arranged wide petaloids, similar to the guards, forming a perfect rose-shaped bloom.

Twelve years ago, when I attended my first Peony show here, Baroness Schroeder was the acknowledged queen. She was beautiful, and among the most costly, being among the very few for which as much as five dollars was asked, and it was common talk then, that the "Peony Boom" had probably reached its height, and would doubtless soon decline. The Baroness is as beautiful today, but no longer queen, for many kinds now bring from ten to fifteen dollars, and twenty-five to thirty dollars is not at all an uncommon value for a number of varieties, and never were these rare varieties more sought after than today.

Among the most talked of Peonies today, besides those of the American growers previously mentioned are first of all Lemoine's Le Cygne, winner of the first prize for the finest single specimen bloom, followed closely by Kelway's Glorious. Along with these should be mentioned Lemoine's Alsace Lorraine, Evangeline, Enchantresse, La Fee, La France, Mirabeau, Mignon, Mont Blanc, Sarah Bernhardt, Solange and Primevere, the nearest approach to yellow; Dessert's Thérese, Francois Rosseau, Mad. De Treyeran, Rosa Bonheur, Tourangelle, and Mons. Martin Cahuzac, the darkest of all Peonies. Kelway's James Kelway, Kelway's Queen, Marchioness of Landsdowne, Miss Salway, Phyllis Kelway, and Venus are all varieties of rare beauty.

Many of the new introductions are only known by reputation, for the expensive kinds are often not allowed to come to perfection, being too frequently divided for the purpose of increasing the stock; it is only when they are grown in private gardens, or in specimen collections, where they may remain for at least four years, that real merits are revealed. Consequently, everywhere, as they develop, we discover new treasures, and alas, too, some few disappointments. Among the pleasant surprises in my collections that I had an opportunity to see in perfection for the first time last year was Galathee, a wonderfully full, strong growing, beautifully formed, flesh white, of great size; Philippe Rivoire, dark garnet, of unusual

form, and long keeping qualities; Madam Gaudichau, nearly as dark, and rivaling Mons. Martin Cahuzac in brilliancy, form, and habit; Madam Savreau, with its delicate combination of lilac-white and amber yellow; Jeanne Gaudichau, wonderfully fine in form and color, and finally Pomponette, with its great, wide-petalled, incurved globes of clear rose. For the first time last year, I saw La France and Le Cygne in all their glory, and many others, because now I have a specimen garden established, where they have been allowed to grow to maturity.

Passing from novelties and scarce kinds to varieties more plentiful which may be had at a cost within the reach of all, and which are obtainable in quantities for mass planting, I would recommend the following list, which comprises varieties that may with certainty be relied upon to flower freely each year under all conditions, all having blooms of the highest quality. The list here given in the various shades covers a period of bloom from earliest to latest in the order named, and coveres a period of from three to four weeks.

White. Boule de Neige, Festiva Maxima, Mme. Calot, Duchesse de Nemours, Couronne d'Or, Albatre, Marie Lemoine.

White, Shaded Cream and Yellow. Lutea plenissima, Alba Sulphurea, Duke of Wellington, Candidissima, Solfatare, Lutea variegata, Primevere, Princess Maude.

Flesh and Light Pink. Umbellata Rosea (the earliest of all), Mme. Coste, Mlle. Rosseau, Marguerite Gerard, Albert Crousse, Eugenie Verdier, Venus, Grandiflora, Modele de Perfection.

Deep Pink and Rose. Edulis Superba, Mons. Jules Elie, General Bertrand, Mme. Forel, Mme. Muyssart, Henry Murger, Milton Hill.

Crimson. Adolphe Rosseau, Pierre Dessert, Mme. Mechin, Bertha, George Washington, Masterpiece, Felix Crousse, Armandine Mechin, Marechal Vaillant, Rubra Superba (the latest blooming Peony of all).

Tricolor. Princess Beatrice, Mme. de Vatry, Alice de Julvecourt, Gloire de Charles Gombault, Philomene, Prolifera tricolor.

The Following is a List of Peonies Especially noted for their Unusually Pleasant Fragrance: Edulis Superba, Comte de Nanteuil, Carnea Elegans (Gr.), Lamartine (Cal.), Mme. Auguste Peltereau, Mme. Geissler, Mme. Thouvenin, Monsieur

Barral, Vicomte de Forceville, Zoe Calot, Dorothy Kelway, Kelway's Glorious, Splendida, Venus, Bertha, Enfante de Nancy, Galathee, La Fee, Mme. de Treyeran, Marcelle Dessert, Mont Blanc (Lemoine), Mireille, Mignon, Primevere.

A Short List of the very best Singles will Include: Albiflora The Bride, Pride of Langport, Madeleine Gauthier, Stanley L'Etincelante, Austin Chamberlain, The Moor.

Special Fine Ones in the Japanese Section are: Attraction, Flamboyant, Fuyajo, Ama-no-sode, Margaret Atwood, King of England, Tora-no-Maki, Lemon Queen, Cathedral, Apple Blossom.

Succession of Bloom.

By including the various early-flowering species, hybrids and Tree Peonies in one's collection, the blooming season may be extended over a period of fully two months. The Tree Peonies bloom quite a month ahead of the Chinensis, beginning early in May. As they do not die to the ground each year, they form in time woody shrubs four to five feet in height, their immense strikingly beautiful blooms sometimes a foot in diameter; they are a wonderful sight. There are color schemes among them never found in the herbaceous section, brilliant scarlets, dark maroons and rich wine colors, delicate blush, pure pink and art shades of mauve and violet. Most of the varieties introduced by the European growers are full-double, while a large number of the Japanese sorts are semi-double and single, with a large cushion of thick golden stamens in the center, which produces a beautiful effect. The Tree Peonies as shown here on the screen were grown in Professor C. S. Sargent's garden at Brookline, mostly from seeds of the Japanese sorts. Seeds should be sown immediately after they ripen, either in the open ground protected by a slight covering, or in boxes placed in a cold frame. The young plants will appear the following spring, and will produce varieties equal in every way to the named kinds.

Peony Lutea, a deep golden-yellow single Tree Peony was discovered a few years ago in the Mountains of Yunnan by the Abbe Delavay. Crosses from this were made by Lemoine with other Tree Peonies. One of them, La Lorraine, was exhibited by me at

the American Peony Show in Philadelphia last June, and was given a special Award of Merit. Its blooms, six inches in diameter, are fully double and are a deep yellow. A new Lutea hybrid soon to be introduced to the trade is Souvenir du Maxime Cornu, a deeper color with a shading similar to that in the Mme. Edward Herriot Rose. Lutea and its hybrids bloom later than the other Tree Peonies.

The dainty fennel-leafed Peony, P. tenuifolia, follows the Tree Peonies, and its dazzlingly brilliant scarlet flowers always attract attention. It requires careful cultivation and only grows about a foot high. Next in point of interest and season of bloom are Lemoine's Wittmanniana hybrids, produced by crossing the pale yellow Peony Wittmanniana, itself a rather difficult species to grow, with P. Chinensis, resulting in types of strong, vigorous growths, with handsome decorative foliage and large single flowers. There are four of them: Avante Garde, pale rose; Le Printemps, creamy yellow; Mai Fleuri, white shaded salmon; and Messagere, sulphur white.

The Officinalis types begin to bloom almost invariably ten days before the Chinensis varieties. Officinalis rubra, the brilliant early red of our grandmothers' gardens belongs to this species, which is a native of Europe. There is a white one, Officinalis alba plena, and a very beautiful large flowered pink one, Rosea Superba, besides a number of named single and double ones not commonly seen. Sabina, L'Oriflamme, Ourika, and La Brilliant are very attractive. Most of the other species are of little interest to the average grower, but I have cut blooms of Triternata and Arietina in April, and of Rubra Superba the 27th of June, a season of quite two months.

Cultivation.

The cultivation of Peonies is so simple that lengthy instructions seem unnecessary and confusing. They will grow in any situation and in any soil, where one would attempt to raise corn or potatoes. In a light sandy soil they bloom earlier, mature more quickly, the colors are lighter and the season of bloom shorter than when they are planted in a heavy clay loam, where it takes the young plants

a year or more longer to reach perfection, but here the growth is stronger, the colors more brilliant, and the flowers are larger and of longer duration. Exactly the same difference is observed between plants grown in the south and middle states, and those grown far north. The Peony is the flower for extremely cold climates, but may be grown in California and in the south if given congenial loamy soil and abundance of water during the growing season and a situation shaded from the sun during the heat of the day.

Peonies are gross feeders, reaching their greatest perfection when well fed and the ground frequently cultivated, until the buds begin to show color. If a drought occurs at that stage they should be well watered. Two things they promptly resent: sour, acid soil and fresh manure in direct contact with the roots when first planted. While they absorb an abundance of food when well established and during their active growing period, to plant the young roots in soil overloaded with fresh manure, especially if it is sour, is sometimes fatal and invariably causes them to become sick. This is undoubtedly the cause of most of the so-called "club root."

The effect is a production of many weak stems, which fail to mature to buds. Peonies should be planted in fresh soil, and any manure used should be thoroughly rotted, carefully worked in, and not allowed to come in direct contact with the roots. Plant so that the eyes are two to three inches below the surface of the ground (too deep planting is injurious). Feeding should be in the form of a good coat of manure over the surface after the ground freezes. This prevents the roots from being thrown out from the heaving caused by alternate freezing and thawing. This covering can be worked into the ground a little distance away from the crowns in early spring, and will furnish the food they need and can then assimilate as active growth begins.

When once planted, let them alone for as many years as they seem to thrive, only dividing and replanting when the plants show indications of deterioration; unless for the purpose of increasing the stock which is another matter. For the purpose of propagating, they should be divided every second or third year, but for garden effect Peonies usually reach perfection the fourth year, continuing in good condition several years longer, and in many instances old

clumps fifteen to twenty years of age continue to thrive. As a general rule, however, eight years is about the limit.

When the clumps begin to show the necessity for replanting, it is best to start again at the beginning with small divisions of clean, smooth roots with three or four eyes, forcing the plant to begin again, and form an entirely new root system. Divisions consisting of large chunks of old crowns simply lie inactive in the ground and sometimes decay entirely. It is a common mistake to purchase old, heavy clumps, with the expectation of getting immediate effect and better results. For the first year probably one may, but never thereafter.

Time to Plant.

Any time in the year when the ground is not frozen, Peonies may be moved successfully, except from the time the buds begin to form until the foliage is matured and the new roots complete their growth, about the middle of August. The very best time is in September and early October. The growth then is fully completed, and the roots in a dormant state. Planted then, the new feeding roots soon begin to form, and strong roots almost invariably bloom the following June. November and December planting is perfectly safe, but bloom must not be expected the first year, and early spring is as good a time to plant as very late fall. If one cannot plant in September or October, it becomes merely a matter of convenience whether to plant in fall or spring.

Diseases.

The Peony has always been considered singularly free from diseases or insect pests, and to all intents and purposes, so far as the amateur is concerned, this is still true. There are two troubles, however, which within the last few years have given rise to a great deal of discussion, most of which I believe has been misleading, and since scientists at a number of experiment stations where investigations have been undertaken, do not fully agree upon the nature or the cause of the trouble, and do not suggest a remedy,

I will simply state my own experiences and conclusions, which I feel sure will tend to allay any needless apprehension on the part of the amateur gardener.

In certain seasons under favorable conditions Peonies are subject to fungous attacks manifested first by black spots on the leaves, second, by a blighting of the buds when half opened, or the decaying of the half-opened buds at the base of the petals, deforming the flower; third, the extension of the fungous growth down the stem, sometimes its entire length, causing what is commonly called "stem rot," which in severe cases extends down into the roots. Sometimes the stem is first affected, causing it to "damp off" and wilt. The conditions favorable to the spread of fungus seem to be moist, humid weather, with frequent showers, followed by hot sunshine. It may be quite severe one season and disappear entirely the following season, and unless the roots themselves are affected, there seems to be no permanent injury, and it is only in a few sections where serious harm has been done, and where I believe the same soil condition and overfeeding, which I have previously explained, have something to do with it. Spraying with Bordeaux mixture as a preventative has been recommended. Where roots are badly affected it is best to replant them in perfectly fresh, sweet soil, free from manure, cutting away all affected parts.

The other trouble is variously known as "Nematodes or Eel worms," "Club roots," "Lemoine Disease," etc. There has been much discussion and difference of opinion regarding these so-called diseased roots. I believe it to be more a condition than a disease; a condition brought on usually, as previously stated, by the excessive use of manure when the roots are newly planted and before they can properly assimilate the overdose. It is manifested by distorted, undeveloped roots, covered with lumpy knots and nodules. An unusual number of eyes are formed, sending up many stems of weak growth, which do not mature flower buds. This condition can also be produced by too deep planting, the use of large divisions of old worn-out roots, or by planting in a sour, pasty soil, or anything which seems to check a healthy action of the roots.

My remedy is to cut the infected roots into very small divisions of one or two eyes, shorten the roots to two or three inches, and

replant in perfectly fresh soil without any manure. This forces an entirely new system of root growth, and so treated, the trouble usually disappears in a year or two. Some varieties appear to be more susceptible than others, and occasionally the trouble persists for a number of years. If these happen to be cheap kinds, it is usually better to discard them and start new with clean roots; with expensive varieties, however, it pays to have a little patience with them. Practically all the novelties from Europe that have come to us from very old gardens, are affected when we first get them, and if we were to reject them on this account, we would have to forego such wonderful varieties as Le Cygne, La France, Mont Blanc, etc., in fact, nearly all the fine new French varieties, all more or less affected when first received, but which after coming from old, worn out soil, soon outgrow this trouble when planted in new ground here. Remember, you can take the smoothest, healthiest roots from one place, plant them in a sour soil oversaturated with fresh manure, and get the most beautiful specimen of club root the following year. Fortunately it is not contagious as many have claimed, for you can plant affected roots in good soil side by side with healthy ones, and I have never known a single case where the healthy roots were affected by them, which convinces me that the sick plants are simply suffering from a cause similar to what we would describe as an inactive liver or a bad case of biliousness in our own systems.

To sum up, fungous attacks are local, due to weather conditions, and only occasionally seriously destructive. Club roots are due to overfeeding, improper soil or planting, and is not contagious. Cut off and burn dead foliage in the fall and use hardwood ashes or lime as a fertilizer for acid soil, applying manure as a top dressing only until plants are in active growth.

THE DISEASES OF ROSES.

By Louis M. Massey, Assistant Professor of Plant Pathology, Cornell University, Ithaca, N. Y.

Read before the Society, February 23, 1918.

The John Lewis Russell Lecture.

The rose was probably the first flower cultivated for ornament or for perfume. Being native to the north temperate zone it occurs within these limits entirely around the world and is grown in all temperate climates. Millions of roses for the market are produced in large glasshouses in order that blossoms may be had throughout the year. In the value of the crop the rose easily leads all other flowers grown under glass, while its importance as a garden plant is too well known to need comment.

That the rose is subject to numerous diseases is a matter of common observation. Doubtlessly all growers and fanciers are familiar with the two most serious diseases, black-spot and mildew. These may be said to be ubiquitous, while the attention of rosarians is focused on various other diseases of more or less general occurrence as they assume an epiphytotic nature. Some of the diseases are fairly common in the wild but have come into prominence only as the rose has become of commercial importance. Other diseases have probably had a later development and are becoming of more and more importance under present intensive methods of propagation. In catering to the demands of the trade and of the fanciers, many new types have been developed by breeding and it is probable that the natural resistance of wild forms brought about through the process of the survival of the fittest has been sacrificed.

The scarcity of definite information is one of the noticeable phases of the subject "diseases of roses." This situation finds explanation in the fact that diseases of ornamental plants in general

usually have been studied by pathologists either as an incident to other investigations or by mycologists interested in taxonomy. Many recommendations for the control of diseases have been made without due consideration being given to the conditions and needs either of the commercial grower or of the fancier. Sprays which will discolor foliage and buildings may be more objectionable than the disease itself, with the result that growers have been loath to use many of them even though their efficiency in suppressing specific diseases has been established. Further investigation of rose diseases is highly desirable.

Black-spot.

Probably the most common and destructive disease of the rose is black-spot. It occurs wherever roses are grown, nearly all the cultivated varieties both out-of-doors and under glass being affected, although not all varieties are equally susceptible. Roses of the Hybrid-Perpetual and Pernetiana groups are considered most susceptible. Laubert and Schwartz (1)[1] hold that bushy sorts are more susceptible than climbers and also that those with thin leaves are more liable to attack. The writer has observed that practically all bush roses, Hybrid-Perpetuals, Hybrid-Teas, Teas, and Pernetianas, are more or less susceptible, while those of the types Multiflora and Wichuraiana are comparatively free from attack. Hybrids of *Rosa rugosa* and moss roses are rarely affected, although Scribner (2) states that "moss roses and those with thick rough leaves seem to suffer more than other kinds." This worker may have confused an abnormal condition of the leaves of moss roses known as "bronzing" with black-spot.[2]

Names applied to the disease. Several names have been used to designate the disease under consideration, among which are black-spot, leaf-blotch, star-shaped leaf-spot, and rose-actinonema. It is perhaps best known as "black-spot," this name being generally accepted and adhered to both by scientific workers and growers.

History and distribution. The black-spot of roses is not a new

[1] Numbers in parentheses refer to a bibliography at the end of this paper.

[2] Stone, G. E., and Smith, R. E. The bronzing of rose leaves. *In* Report of the botanist Mass. Agr. Ex. Sta. Rept. **11**: 156–159. 1899.

disease, being first noted in Italy in 1824.[1] It was probably present many years before this date and has long been known to the rose-growers of Europe. In 1825 the Hybrid-Perpetual began to take first place in the rose world, and as this class is probably the most susceptible to black-spot it is not surprising that references to the disease began to appear more and more in articles on the cultivation of roses.

Saccardo [2] notes the occurrence of black-spot in France, England, Italy, Belgium, Germany, Austria, Portugal, and North America. No special attention has been given the disease by American investigators until in more recent years when, due to the more intense cultivation of the rose or the production of more susceptible varieties, it has come to be considered the worst enemy of this plant. Possibly the first report of the disease in America was by Scribner (2) in 1888. Both Maynard (3) and Humphrey (4) record observations on the disease the following year. Subsequently the disease has been reported as occurring in practically every part of the United States and it is safe to state that black-spot exists wherever roses are grown.

Economic Importance. Black-spot is probably the most important of all the many diseases of the rose. It is both an enphytotic and an epiphytotic disease of out-of-doors plants, being more or less abundant every year and in seasons especially favorable for its development, attacking and defoliating a large percentage of all garden roses. Under glass the disease is practically always present, ready to become epiphytotic as soon as proper conditions of temperature and moisture develop. The extreme susceptibility of Hybrid Perpetual roses to black-spot is one of the factors contributing to their decrease in popularity. The great susceptibility of the Pernetiana group to this disease threatens to be the limiting factor in its popularity unless some practical methods of control are developed.

Symptoms. Although the lesions sometimes occur well down on the petioles and even in the case of some varieties on all the aerial parts of the plant [3] the disease is confined practically entirely to the

[1] Fries, E. Observationes mycologicae, p. 207.

[2] Saccardo, P. A. Sylloge fungorum **3**: 408. 1884.

[3] Chifflot, J. The extension of Marsonia rosæ on rose bushes. Assoc. Franc. Avanc. Sci. Comp. Rend. **43**: 426–428. 1914.

leaves. The more or less circular spots may reach a diameter of a centimeter or more, are black in color and are characterized by radiate-fibrillose margins. They usually appear late in the spring or early in the summer and occur only on the upper surface of the leaf. The spots are small at first but increase in size as the disease progresses. Often a number of them coalesce and in severe attacks the entire leaf may be covered with large dark patches. In the latter part of the season the spots frequently grow light in color and dry in the center showing this part of the leaf to be entirely dead.

Very commonly the leaf tissue adjacent to the black spots becomes chlorotic before the leaves fall from the plant, and not uncommonly all of the uninvaded tissue becomes yellow before defoliation occurs. The leaflets may turn yellow in spots, while sometimes the yellow area is limited to a band outside the black spot. Commonly, and especially during the autumn the yellow color appears at the apex of the leaflets whence it spreads downward and is succeeded by brown. A leaf with a green base and brown tip with a yellow band between is very characteristic of this disease.

Premature defoliation is one of the most pronounced characteristics of this disease. Affected leaves may fall before they turn yellow, the slightest jar or breeze often causing them to drop in great numbers. Diseased plants usually have a partially defoliated appearance.

The size and shape of the black spots, the rapidity, and the extent of defoliation of plants, seem to vary with the variety. No reports of observations on these points are to be found in literature.

Etiology.

Black-spot of the rose is caused by a fungous parasite, *Diplocarpon rosae* Wolf, long known under the name of *Actinonema rosae* (Lib.) Fries.

Life History of the Parasite.

Diplocarpon rosae has two phases in its life cycle — an actively parasitic phase developed during the summer and a saprophytic

phase in which the fungous lives during the winter on dead and decaying tissue.

An examination of the lesions on the leaves during the summer will show the presence of small black pustules which are the fruit-bodies of the fungus. In these fruit-bodies the conidia or summer-spores are born. These spores are matured rapidly during the growing season and are blown about by the wind, thus distributing the fungus and bringing about successive infections with new crops of conidia. This phase of the fungus is the one most commonly met with and has been known under the name of *Actinonema rosae* (Lib.) Fries for many years.

During the winter the sexual or ascigerous phase develops. When leaves affected with black-spot fall to the ground during the summer and autumn, the fungus does not die but lives over winter as a normal saprophyte. If examined microscopically during the spring it will be found that another spore-form has developed. In this stage spherical fruit-bodies (perithecia) bearing numerous sacs or asci, each of which contains eight ascospores, are produced in the old leaves lying about on the ground. These fruit-bodies serve to carry the fungus over the winter, the spores being mature at the time of opening of the rose leaves in the spring.

Inoculation. The old leaves on the ground are to be considered the chief source of primary inoculum in the spring. However, the fungus is carried over winter on plants under glass from which conidia could be carried readily by the wind to the newly developing leaves on out-of-doors plants. Growers frequently buy pot grown plants in the spring to plant in their gardens and are likely to thus carry the fungus to the plants which were out-of-doors during the winter. Scribner (2) who was acquainted only with the asexual stage suggests that the spores (asexual) lodge on the buds in the autumn and remain there dormant until the leaves have expanded the following autumn. In warmer climates the conidia may live over winter and serve as inoculum the following spring. No special investigations on this point have been reported in literature. Wolf (5) could find in wintered material no acervuli which were bearing conidia. It seems very improbable that the conidia winter in any sections of Massachusetts or places having similar temperatures. The evidence derived from observations

on the parasite warrant the conclusion that, as has been found to be true of many fungi, this fungus is carried through the winter on fallen leaves in which the ascosporic stage develops the following spring.

Although when mature the asci discharge the spores through an apical pore formed by the rupture of the wall, the spores are apparently not discharged with violence. Wolf states that they merely pile up in a whitish heap in the opened perithecium. How they reach the unfolding leaves of the plant has never been definitely determined, but it is probable that insects, splashing rain, and possible the wind play an important part. Man, in cultivating, may also serve as an agent of inoculation.

The maturity of the ascospores and the occurrence of rainy periods when the spores are mature are factors governing spore discharge.

Inoculation. The ascospores which are probably distributed during a rainy period require moisture to germinate and penetrate the host. They germinate within twenty-four hours. Wolf (5) found the period of incubation to be about ten days, small black areas being evident on May 7 from inoculations made on April 27.

Infection. Infection occurs by the entrance of the germ-tube directly through the cuticle of the leaf. The resulting mycelium remains for some time immediately beneath the cuticle, later penetrating the tissues below, first filling the epidermal cells and only in advanced stages of the disease penetrating the mesophyll. The black appearance of the spots is not due to the fungus, which is almost colorless, but to the disintegration of the cells below the spot.

Environmental Relations.

Temperature and especially moisture are factors which may influence the severity of the disease by their effect on the parasite and the host. It is a matter of common observation that greenhouse roses are more subject to this disease in the spring and autumn when extremes of temperature are most likely to occur. Frequent rains and general cloudiness are important factors at these times. Many growers of indoor roses claim that if the plants

can be carried through late summer and autumn prior to the time when firing begins without suffering an epiphytotic of black-spot there is little danger of plants being badly diseased during the winter. No doubt exceptions occur, but the most badly diseased houses noted by the speaker in visits to growers were those where firing was begun late. The natural heat of summer and artificial heat of winter quickly dries off the foliage and must thus be instrumental in lessening infection. It is very improbable that the ascigerous stage develops in the fallen leaves under glass.

Out-of-doors, where primary infection is initiated by ascospores formed during the winter in old leaves left lying on the ground, it is obvious that the spring rains are important factors, as moisture is necessary for the discharge of these ascospores from the perithecia. Moisture supplied either by rainfall or by dew is probably necessary for the germination of both the ascospores and conidia so that a greater amount of disease may be expected during rainy seasons. It is a matter of common observation that whereas more or less black-spot is present every year, epiphytotics on out-of-doors plants only occur during seasons of heavy rainfall. The precipitation of dew on the foliage during the autumn when cold nights and warm days prevail may account for the increased amount of disease at this time. Lesions on the leaves are more numerous and perhaps larger in rainy, cloudy seasons than in dry seasons. When conditions favorable to black-spot are known a big step will have been taken toward the control of this disease, especially under glass.

Control.

Sanitation. Since the fungus lives over winter in fallen leaves, where the ascospores are produced which serve as the source of primary infection in the spring for out-of-doors roses, it follows that these should be carefully collected and burned late in the autumn. It is also advisable to keep the benches free from old leaves affected with the disease, for they bear the summer spores and thus serve as sources of infection. Where a rose garden consists of only a few plants much may be accomplished by picking and burning every leaf as soon as it shows signs of disease.

Protection. Protection by spraying is the usual recommendation for the control of the disease of roses caused by *Diplocarpon rosae* Wolf. Of the numerous fungicides recommended in literature probably bordeaux mixture and ammoniacal copper carbonate are the two most often mentioned. Statements to the effect that the latter fungicide is as efficacious as the former are common in literature. Results of the following experiments conducted in 1917 indicate that ammoniacal copper carbonate is not as efficient as bordeaux mixture for the control of the disease. A mixture of 90 parts finely ground sulfur and 10 parts powdered arsenate of lead dusted upon the plants proved to be as efficient as bordeaux mixture and its use rendered the plants far less unsightly than the latter fungicide. Lime-sulfur solution, 1 part of the commercial concentrated solution to 50 parts water, was found to be more efficient than ammoniacal copper carbonate and probably as much so as bordeaux mixture and the sulfur-lead dust. However, lime-sulfur discolors the foliage almost as much as bordeaux mixture.

Experiments in the nursery.

In the experiments performed in the nursery there were nine rows of rose plants, each of a single variety, the following eight varieties being involved: J. B. Clark, Gruss an Teplitz (2 rows), Prince Camille de Rohan, Clio, Mrs. John Laing, John Hopper, Madame Gabriel Luizet, and Margaret Dickson. A part of each row of plants was included in each of the different plats. There were 450 plants in each of the five plats which were treated as follows: plat 1, dusted with sulfur 90 parts, and arsenate of lead 10 parts; plat 2, sprayed with bordeaux mixture, 5–5–50; plat 3, sprayed with lime-sulfur solution 1 to 50; plat 4, sprayed with Hammond's copper solution,[1] 1 to 100; plat 5, untreated.

The first applications of dust and spray were made on May 31. All of the buds had opened and most of the leaves were well developed on this date. Subsequent applications were made on June 12, June 23, July 4, July 24, August 2, and August 25. Final data were recorded on September 13, the middle row (variety Clio) being

[1] Hammond's Copper solution is a cupro-ammonium wash containing according to the manufacturer 3.05 percent metallic copper.

selected and the number of infected leaflets counted on twenty plants. The part of the row included in each plat consisted of approximately sixty plants, and the data were obtained from every other plant in the central area. Defoliation was not taken into consideration. From observations it was determined that the amount of defoliation varied directly with the percentage of leaflet infection in the various plats.

The percentage of diseased leaflets for each plat was as follows: sulfur 90 parts and arsenate of lead 10 parts, 7.66; bordeaux mixture 5–5–50, 8.51; lime-sulfur solution 1 to 50, 24.43; Hammond's copper solution 1 to 100, 37.77; untreated 80.

A point to be noted in the above experiment is the fact that the plat treated with lime-sulfur solution was situated on low ground where there was poor drainage. Owing to the heavy precipitation throughout the season these plants were subjected to more moist conditions than those in the other plats which had better drainage. Consequently it is probable that lime-sulfur is more efficient in the control of rose black-spot than the above results would indicate. This probability is further emphasized by the following experiments.

Experiments in the test garden of the American Rose Society.

A somewhat similar experiment for the control of *Diplocarpon rosae* was conducted in the test garden of the American Rose Society at Ithaca, New York. Here the plants were arranged in beds, there being on an average, four varieties of six plants each in a bed. There were six plats, each of which included twelve beds, treated as follows: plat 1, dusted with sulfur 90 parts and arsenate of lead 10 parts; plat 2, sprayed with ammoniacal copper carbonate;[1] plat 3, sprayed with lime-sulfur 1 to 50; plat 4, sprayed with fungi-bordo 5–5–50;[2] plat 5, sprayed with Hammond's copper solution 1 to 100; plat 6, untreated.

[1] The ammoniacal copper carbonate solution was composed of 5 ounces of copper carbonate, 3 pints of ammonium hydroxid (sp. gr. 0.90), and 50 gallons of water.

[2] Fungi-bordo is a dry, finely ground mixture of anhydrous copper sulphate and hydrated lime. It was used at the rate of 10 pounds to 50 gallons of water which is approximately equivalent to a 5–5–50 bordeaux mixture.

During the summer thirteen treatments were made on the following dates: May 26, June 4, June 11, June 18, June 24, July 3, July 13, July 20, July 31, August 9, August 21, August 29, and September 9.

Final observations were made on September 24. Due to the fact that the plats did not contain the same varieties it was impossible to compare the treatments by determining the percentage of diseased leaflets. Gross observations were made by the writer who also obtained the opinion of the gardener and others not directly interested in the work. The plants of the dusted plat and those sprayed with fungi-bordo and lime-sulfur solution stood out in sharp contrast to the other plants in the garden due to their healthy leaves and heavy foliation. It was impossible to determine from gross observations which of these treatments was most efficient. The plats treated with ammoniacal copper carbonate and with Hammond's copper solution contained but slightly less affected plants than the check, and marked defoliation occurred in all three plats.

From these experiments it would seem that lime-sulfur solution 1 to 50, bordeaux mixture 5–5–50, and the dust mixture consisting of 90 parts finely ground sulfur and 10 parts arsenate of lead, are three efficient fungicides for the control of black-spot of the rose, while Hammond's copper solution and ammoniacal copper carbonate solution are much less efficient. Due to its ease of application and to the fact that its use discolors the foliage less than the other two, the sulfur-lead dust [1] is to be given the preference.

Powdery-mildew.

Powdery-mildew is one of the most common and injurious diseases of the rose, especially of plants grown under glass. Out-of-doors plants are commonly attacked, the Crimson Rambler and related forms being especially susceptible. Varieties differ greatly in susceptibility. The disease was held by investigators to occur

[1] The sulfur-lead dust was obtained from the Union Sulphur Company and was so finely ground that at least 98 per cent would pass through a 200-mesh sieve. It was applied with a hand duster.

on the peach, apricot, almond, and cherry-laurel until Woronichin (9) proved it to be confined to the rose.

Symptoms. The first signs of the disease are grayish or whitish spots on the young leaves and shoots. Frequently, the unopened buds are white with mildew before the leaves are affected to any great extent. These spots quickly enlarge, a felt-like coating of a white, powdery appearance being commonly found on the stems and thorns. Later the mildew appearance is less conspicuous or entirely lost, the affected areas turning black.

Dwarfing, curling and various deformations of young leaves, stems and buds occur. Injured leaves may fall, and the leaf surface of the plant may be greatly reduced. Growth and flower production is materially interfered with, young buds being frequently attacked and rendered entirely worthless.

Etiology.

Powdery mildew is caused by the fungus *Sphaerotheca pannosa* (Wallr.) Lév. *rosae* Wor.

Identity. The fungus was first reported by Wallroth[1] under the name of *Alphitomorpha pannosa.* Subsequently the fungus was called *Eurotium rosarum* by Greville,[2] *Erysibe pannosa* by Schlechtendahl[3] and Link,[4] and *Erysiphe pannosa* by Fries.[5] Léveillé[6] transferred the fungus from the genus Erysiphe to Sphaerotheca.

Salmon (7) states that roses in America are attacked by two species of fungi, viz., *Sphaerotheca pannosa* and *S. humili* and that the American fungus which has passed under the name of *S. pannosa* is for the most part *S. humili.* He had seen only two specimens of true *S. pannosa* from America. Stewart (8) reports several cases of rose-mildew in which the fungus was unquestionably *S. pannosa.*

[1] Wallroth, K. F. W. Naturgeschichte des Mucor Erysiphe L. Berl. Ges. Nat. Freunde Verhandl. **1**: 6–45. 1819.
[2] Greville, R. K. Scottish Cryptogamic Flora **3**: pl. 164. fig. 2.
[3] Schlechtendahl, D. F. L. von. Flora Berolinensis **2**: 168–170. 1824.
[4] Link, H. F. Willdenow, Species Plantarum **6**: 104. 1824.
[5] Fries, E. Systema Mycologicum *3*: 236. 1829.
[6] Leveille, J. H. Ann. sci. nat. III, **15**: 138, pl. 6, fig. 8. 1851.

Woronichin (9) reports experiments with the fungi causing powdery-mildew of the rose and peach in which negative results were obtained from inoculations on the peach with the fungus causing the disease of rose. He also states that a study of the perithecia, asci, and spores of the fungi from the two hosts showed differences in their dimensions. He concludes that the biological and morphological differences noted are sufficient to separate the species into the varieties *S. pannosa rosae* and *S. pannosa persicae.*

Morphology. Under the microscope the white patches on the rose plant are seen to consist of a mould-like growth (mycelium) composed of slender white threads with numerous branches which form a net-work over the surface of the leaf. At various points upright branches are developed which bear chains of egg-shaped spores. These spores are easily detached and lie in masses giving the older spots a powdery appearance. They are produced throughout the year under glass, but only during the summer on plants growing in the open.

At various points the mycelial threads are attached to the surface of the host, minute branches called haustoria being sent into the outer cells of leaf or stem from which the fungus obtains its food supply. The cells into which the haustoria are sent may be stimulated at first but are killed sooner or later.

Somewhat rarely, and probably only out of doors, ascospores are produced in spore-cases called asci which in turn are born singly in dark fruit-bodies (perithecia) embedded in the felt-like growth on stems, thorns and leaves. These ascospores can live over winter out-of-doors and may serve as the inocula the following spring.

Life history of the parasite.

Norton (10) states that it is probable that the mycelium of the fungus is able to live over winter out-of-doors in the buds of roses. Others assert that the mycelium is perennial, reappearing in successive years on the same shoots of infected plants. Salmon notes that in specimens examined the fresh centers of disease which appear in the spring did not occur at the places where the fungus grew in the previous year. The fact that sexual spores are somewhat rare

might be considered as evidence favoring the claim that the mycelium is perennial. In countries of warm climates the fungus is doubtless carried throughout the year in the asexual stage as is true on roses grown under glass where the temperature does not fall sufficiently low to kill the spores and mycelium.

There are, then, two and possibly three sources of primary infection in the spring. First and of primary importance is the production of ascospores which live over winter in perithecia on plants grown out-of-doors. These spores are distributed by the wind, rain, man, and other agents and, under proper conditions of temperature, moisture and position, germinate and produce infection. The second source of inoculum for roses in the open is the distribution of asexual spores formed throughout the year on roses under glass. These spores are very light and might readily be carried by the wind for great distances. Growers frequently buy pot-grown roses in the spring to plant in their gardens. Some of these plants may be affected and often the fungus spreads quickly to other bushes. The third possible source of inoculum is the production of conidia by mycelium which has overwintered on plants in the open. Some doubt exists, as stated above, as to whether or not the mycelium is perennial in sections having relatively cold winters.

Spores, then, either ascospores or summer spores, are carried to rose plants in the spring where under proper conditions they germinate. The germ-tube coming from the spore quickly elongates, branches and soon establishes a food relation with the host by sending haustoria into the epidermal cells. Very soon thousands of new spores are produced which when mature are carried by the slightest air currents to other parts of the plant and to other bushes.

Many florists believe that rose mildew is caused by drafts, having noticed the initial appearance of the disease in the areas in the greenhouse near doors or broken panes of glass. Needless to say mildew cannot develop without the presence of the fungus, the drafts serving as bearers of spores and possibly bringing about favorable conditions for infection, either by its effect on the host or on the fungus, or on both.

Control.

A. Roses out of doors. The efficiency of sulfur fungicides for the control of rose mildew has long been recognized. Lime-sulfur and other liquid sprays are more or less effective but owing to the time and labor involved in applying spray solutions and to the unsightliness brought about by their use, an efficient dust mixture is preferable. Stewart (11) reports good control of rose mildew by the use of a dust mixture consisting of 90 parts sulfur and 10 parts arsenate of lead. A similar mixture was used by the writer in 1917 and it was found to be decidedly more efficient than lime-sulfur solution 1 to 50 or bordeaux mixture 5–5–50.

A row of Crimson Rambler bushes planted thickly and forming an arbor about five hundred feet in length was divided into four sections of equal length and treated as follows: section 1, sprayed with bordeaux mixture 5–5–50; section 2, sprayed with lime-sulfur solution 1 to 50; section 3, dusted with sulfur 90 parts and arsenate of lead 10 parts; section 4, untreated.

The first application of dust and spray was made on August 2. Mildew appeared between this date and August 16, when the second application was made. Another application was made on August 25. The experiment was terminated on September 13. On this date the dusted bushes were practically free from mildew, only a few infected shoots being apparent. The bushes treated with bordeaux mixture and lime-sulfur were severely infected and were but slightly less free from the disease than the untreated bushes. Besides its superiority in fungicidal value the dust mixture rendered the plants far less unsightly than the bordeaux mixture or the lime-sulfur solution. The latter fungicide appeared to be slightly more efficient than bordeaux mixture.

B. Under Glass. Florists commonly paint the heating pipes with mixtures of sulfur and lime for the control of mildew, the sulfur being thus evaporated and condensed on the plants where the fungus is killed. Maynard (12) recommends the use of evaporated sulfur, a small kerosene stove with a thin iron kettle being used and the sulfur kept boiling two or three hours a week in a closed house. Both methods have given good results, the use of a

kerosene stove or other means of heating the sulfur being necessary at times when the houses are not artificially heated. The use of the sulfur-lead dust on roses under glass will undoubtedly control the disease and may in many cases be a more desirable method than that of using evaporated sulfur.

Crown-Canker.

An important disease of the rose, to which the name crown-canker has been given, was first observed by the writer (13) in September, 1916, affecting American Beauty plants. The grower stated that he had had the disease under observation during the past four or five years, a few plants being affected each year and the disease being confined to a single house.

Subsequently plants affected with the crown-canker disease have been received from eight growers, the states of Missouri, Pennsylvania, Indiana, Michigan, Massachusetts, and New York being represented. A Missouri grower observed the disease in 1916 on the varieties Hoosier Beauty and Ophelia growing on their own roots. An eastern grower was of the opinion in 1916 that all of his many thousands of plants were affected, and it is the opinion of the writer, after having examined his plants, that at least a very large percentage of them were diseased. During the four years prior to 1916 increasingly poor results were obtained by this grower who when interviewed in November, 1916 was planning to destroy his plants, sterilize houses and soil, and begin anew with healthy stock.

Rose plants of the varieties Hoosier Beauty, Ophelia, Hadley, Mrs. Charles Russell, Sunburst, American Beauty, and many seedlings have been observed affected with the disease. Both grafted plants and those growing on their own roots are affected. It is questionable whether or not any variety is immune. Indications are that this may prove to be the most important disease of roses grown under glass. To date no record has been made of this disease on out-of-doors plants.

Symptoms. Diseased plants are affected at the crown, usually just at the surface of the soil, the lesion in advanced cases frequently

extending several inches above the soil. The writer has not determined to what extent the root systems are commonly affected. However, lesions have been observed near the tips of roots of four-years-old plants, and of several plants examined unquestionably the entire root system of each plant was affected. The union of scion and stock, and the area immediately above, is the most common point of attack.

The first indication of the disease is a slight discoloration of the bark. As the disease advances the color deepens to black and the tissue appears water-soaked (plate 1, figs. 1, 3). At first the lesions are irregular in outline with a somewhat sharply defined margin. Later as the affected area increases in size the blackened color of the diseased area is blended more with the healthy tissue. The lesions frequently encircle the stem. Soon cracks appear in the bark extending in to the wood (plate 1, fig. 2). Later a swelling of the stem as from girdling occurs at and above the affected area, the cracks becoming deeper and more evident. In old lesions the black, water-soaked appearance is lost. Sometimes the stem is encircled by a shrunken area which contrasts sharply with the swollen area immediately above.

One very noticeable characteristic of this disease is the punky consistency of the diseased tissue, especially that affected underground. When scraped, the bark, sapwood and frequently the roots appear punky and lifeless, not uncommonly in areas where no definite lesion is evident.

Suckers developing from the roots of diseased plants are usually spindling and yellow. They are commonly affected at the point of attachment to the main stem, the tissue being blackened and of a punky texture.

Affected plants do not die quickly but linger on and yield increasingly poor and few blossoms. It is practically impossible to force such plants to increased activity by heavy applications of fertilizers. The foliage of plants affected with this disease is frequently of a lighter green color than that of healthy plants. Probably the number of plants actually killed within the duration of time they are usually kept by growers is very small, but the normal activities of the plant are so materially interfered with that diseased plants can be grown only at a financial loss.

Cause. Crown-canker of the rose is caused by the fungus *Cylindrocladium scoparium.* This organism was first reported from Ohio where it was found growing saprophytically on a pod of the honey-locust. Later it was found living on dead paw-paw leaves. The writer described the fungus as a parasite on the rose in December, 1917.

Although spores of the fungus have never been found by the writer on plants growing in the benches, they frequently develop in from two to five days on diseased rose plants when kept in a moist chamber. Consequently they are probably formed in the greenhouse on plants growing under moist conditions. Spores placed in water germinated after three to twelve hours. They are thin walled and probably not long lived. Just what part they play in disseminating the fungus is unknown. Infection of plants is readily obtained by spraying them with water containing viable spores in suspension.

Moisture Relation.

Moisture apparently plays an important rôle in the severity of the disease. Lesions on stems well above the surface of the soil resulting from artificial inoculations appear to dry and make no further progress unless kept moist by being surrounded with wet cotton or some such substance. Inoculations made at a point several inches above the soil frequently result as above. One grower who has had considerable experience with crown-canker is of the opinion that the disease is lessened by placing plants with the graft union above the soil, thereby preventing infection at this point. The same grower stated that the seriousness of the disease is reduced by pulling the soil away from the crown of the plant, thus creating a more dry condition at this point. These are undesirable methods, for grafted plants usually develop roots at the graft union when planted sufficiently deep. It is the opinion of the writer that the fungus is low in parasitism and that conditions of moisture are important factors in its development.

Control. Although experiments are under way in the hope of developing some method of controlling the crown-canker of rose no definite results are yet at hand. From the nature of the fungus

and judging from results to date it would seem that control will resolve itself into some method of soil treatment, probably soil sterilization. The fungus grows well on both acid and alkalin media so that the possibility of control by developing an acid or alkalin condition of the soil does not appear to be promising. Soil sterilization and the exercise of care in using only healthy stock and scions for grafting may be the only feasible method of controlling the disease. Investigations of control measures are being conducted in cooperation with Professors A. V. Osmun and P. J. Anderson of the Massachusetts Agricultural Experiment Station. Progress to date has been encouraging and it is hoped that something definite can be offered growers in the near future.

Crown-Gall.

This is a very common disease of the rose, both of plants grown under glass and out-of-doors. It is the common crown-gall disease of the nursery, affecting many woody plants, trees, and shrubs, as well as herbaceous plants. Roses in benches are frequently severely affected. Much interest in recent years has been attached to the study of this disease because of its resemblance to malignant human tumors, with the possibility that light may be thrown upon the latter.

History and distribution. The disease has been known in Europe for over fifty years, being generally ascribed to frosts and mechanical injuries by many workers. According to Smith, Townsend and Brown (14), Scalia described a tumor occurring an old stems of the rose near the surface of the earth, but also frequently higher up. It is impossible to be quite certain that the disease described by Scalia is identical with the crown-gall of the rose as it occurs in this country.

In the United States references to the disease in literature begin about the year 1892, but undoubtedly the disease has been present for a long time. It has been reported as occurring in all the states.

Economic importance. Opinions differ as to just how much damage this disease causes to roses. Skilled gardeners are generally of the opinion that serious injury is done, diseased plants being

smaller and bearing less foliage and less vigorous flowers. It seems obvious that the energy used up in the production of galls, which are often large, must be at the expense of the general needs of the plant, resulting in an inferior product.

Symptoms. Crown-gall exhibits itself in the production of galls or tubercles, usually on the roots or the crowns of the plants, but not infrequently on parts of the plant above ground. Smaller and younger galls range in color from green to white and are soft and spongy. As the galls become older they increase in size, frequently reaching a diameter of several inches and darken in color externally. The surface is rough, sometimes convoluted, and usually the galls become firm and hard with age.

Etiology.

Crown-gall is a bacterial disease caused by *Bacterium tumefaciens* Sm. and Town.

The greater number of European observers assigned the cause of the disease to physical agents, such as late frosts and winter killing. Others thought the disease might be brought about by injuries received from insects, while still others believed that the disease was caused by bacteria, fungi, or slime-moulds, although the pathogenicity of none of the suspected organisms was established.

In April, 1907, Smith and Townsend (15) described a plant tumor of bacterial origin, giving conclusive proof of the pathogenicity of the organism *Bacterium tumefaciens* which was isolated from the galls of the Paris daisy. Galls were produced on tobacco, tomato, potato, sugar-beet, hop, and peach by artificial inoculation.

In December, 1908, at a meeting of the Botanical Society of America, Townsend (16) reported the results of further experiments with the organism from the Paris daisy. A bacterium was isolated from a gall on roses and other plants which appeared to be identical with that isolated from the daisy. The organisms from the different hosts were cross-inoculable. Smith, Townsend and Brown (14) report successful infections on the rose with the pathogene isolated from galls on this and other plants, and records

experiments tending to show a wide range of natural cross-inoculability.

Life History. It is probable that the bacteria causing crown-gall must enter the plant through wounds. The development of certain cells in the host plant is stimulated resulting in the formation of large galls. The size of the tumors, other things being equal, depends on how rapidly the plants are growing. The galled tissue is often of a soft fleshy nature and is much subject to decay. Tumor strands develop into the normal tissue as roots of the tumor, in the substance of which secondary tumors arise. These secondary tumors rupture their way to the surface.

The bacterium is a soil organism, probably being able to live in the soil for years without losing its virulence. Its entrance into the host is favored by careless grafting and by the presence of borers, nematodes, and the like.

Control. Since *B. tumefaciens* is a soil organism, growers should plan to keep their soil free from it by planting only healthy stock. All plants should be carefully inspected for galls before they are set in the benches. It is advisable to burn all cuttings showing galls. Do not plant healthy plants in soil in which diseased plants have grown. Infested soil should be sterilized by steam or replaced by soil in which no diseased plants have grown. When infested soil is removed from the greenhouse the benches should be thoroughly disinfected. The removal of galls from plants is of doubtful value. Once a plant is affected no treatment will cure it.

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Explanation of Plates.

Plate 1. Rose plants affected with crown-canker. Fig. 1. Stem of an Ophelia plant artificially inoculated with mycelium of fungus. Fig. 2. Hoosier Beauty plant showing cracking at crown. Fig. 3. American Beauty plant showing black water-soaked area at crown. Figs. 1 and 2, natural size; Fig. 3, three-fourths natural size.

Plate 2. Fig. 1. Plant affected with crown-gall. Note the large gall formed at the crown of the plant. Fig. 2. Black-spot lesions on rose leaf. Natural size.

MASSEY—DISEASES OF ROSES

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